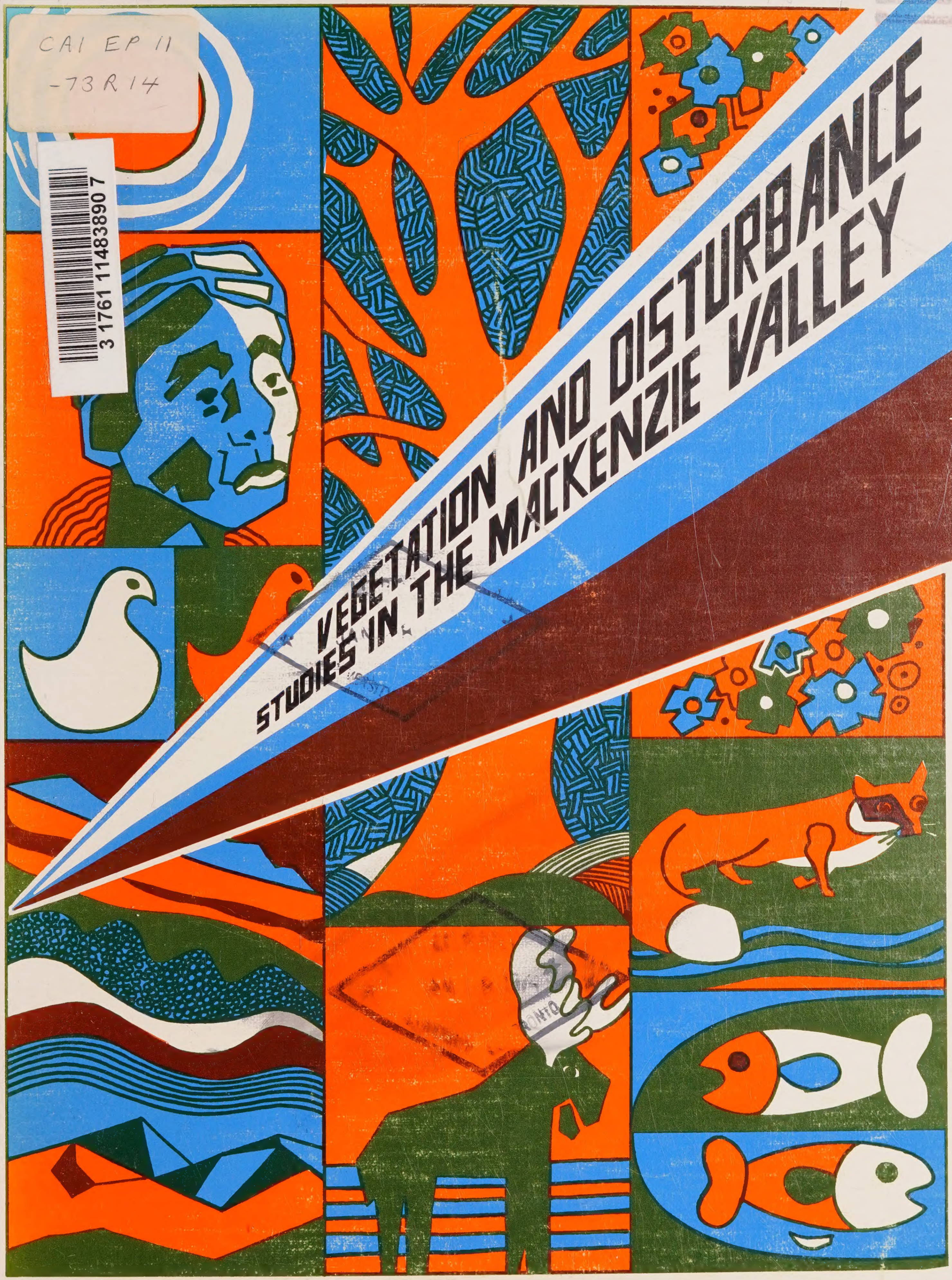
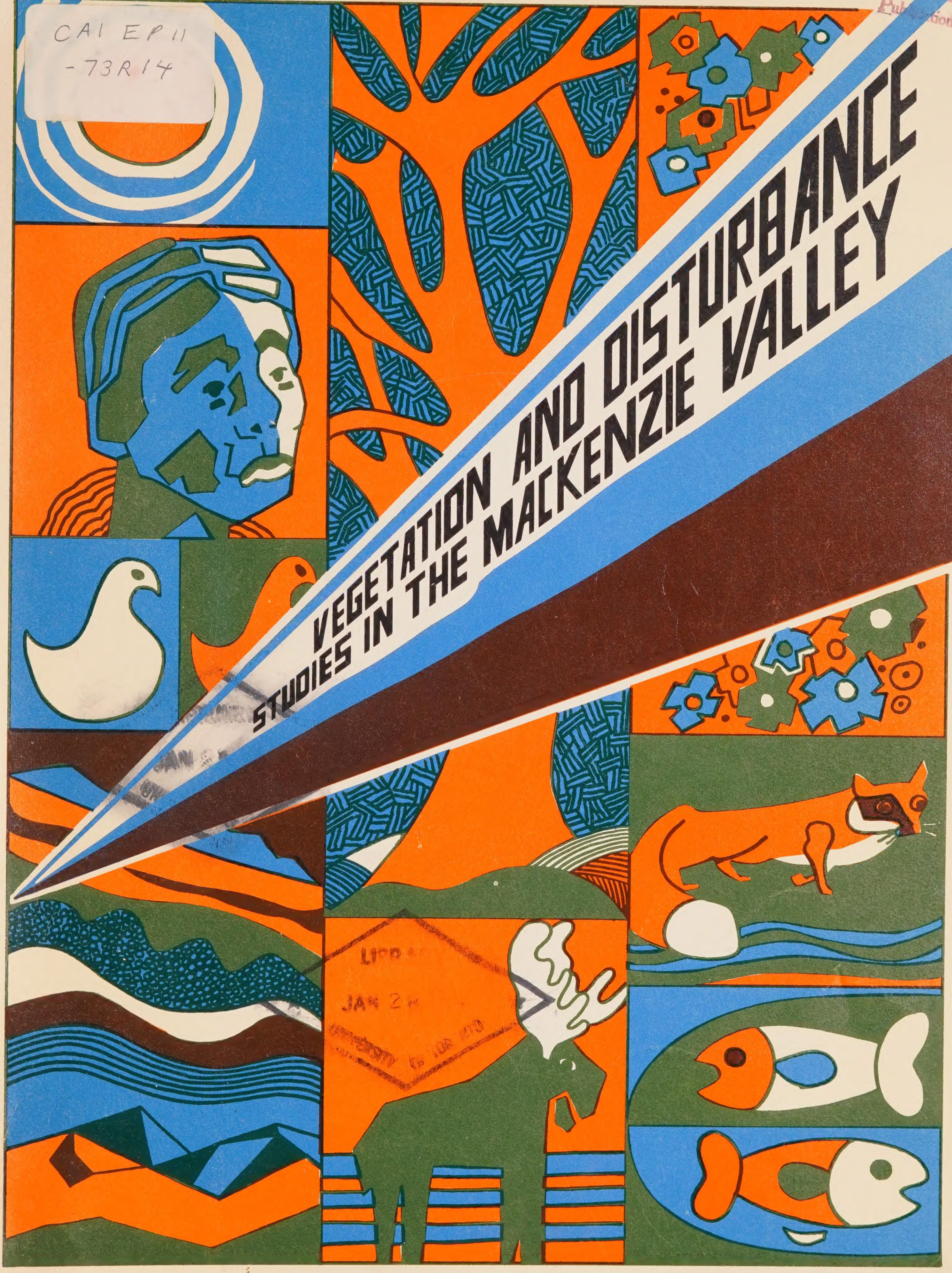

VEGETATION AND DISTURBANCE
STUDIES IN THE MACKENZIE VALLEY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STUDIES OF VEGETATION, LANDFORM AND PERMAFROST
IN THE MACKENZIE VALLEY:
Some Case Histories of Disturbance

by

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Environment Canada

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STUDIES OF VEGETATION, LANDFORM AND PERMAFROST IN THE MACKENZIE VALLEY:

Some Case Histories of Disturbance

R. M. Strang

This is one section of a three-part contribution to the Task Force on Northern Oil Development by the Northern Forest Research Centre, (Canadian Forestry Service, Department of the Environment), Edmonton, Alberta. This particular contribution deals with the effects of disturbance in permafrost terrain and the kind and degree of damage caused by different agents; another discusses the mapping of landscape permafrost features using air-photograph interpretation, checked by ground inspection (C.B. Crampton); and the third describes a study of terrain-vegetation-permafrost relationships, used to characterize surficial geological map units (S.C. Zoltai).

The data for these contributions were obtained by investigations carried out under the Environmental-Social Program, Northern Pipelines, of the Task Force on Northern Oil Development, Government of Canada. While the studies and investigations were initiated to provide information necessary for the assessment of pipeline proposals, the knowledge gained is equally useful in planning and assessing highways and other development projects.

I am happy to acknowledge the valuable help given by Messrs. C. Brodie, D. Kvill and A. Marsh* in the field and to recognize the very considerable contributions of Mrs. M. Leitch** and A. Marsh to identification of the large number of plant specimens. Lists of vascular plants, mosses and lichens, by vegetation units within each of 8 geographic areas are available on open file ESP-103 and may be purchased from Campbell Printing, 880 Wellington Street, Ottawa, Ontario, K1R 6K7, attention Mr. C. Trueit.

* Funded by D.I.A.N.D.'s Arctic Land Use Research programme.

** Funded by Forest Management Research Institute, Environment Canada, Ottawa

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1 SUMMARY

1.1 A study of the effects of disturbance on a wide range of site-types in the Mackenzie Valley was made in 1972. This was one element in the Federal Government's investigations of environmental factors and parameters to provide information from which to develop guidelines governing oil- and gas-pipeline development in northern Canada. The study provided detail to amplify extensive mapping of vegetation and landform in relation to permafrost. The intent was to produce a system of terrain sensitivity rating.

1.2 Soil and vegetation at some 200 sites, where disturbances had occurred, were examined in detail to ascertain the consequences of a particular disturbance and these consequences were subjectively evaluated. In tabular summaries, the sites described in the study were related to the landform units mapped by other researchers in the Canadian Forestry Service.

1.3 The studies indicated that site factors and kinds of disturbance were too variable to permit the application of anything more than a generalized sensitivity rating. They did, however, show which site factors were most likely to suffer damage from disturbance, provide the basis for a set of recommendations and lay the groundwork for future long-term studies.

2 INTRODUCTION

2.1 Background

Exploration for oil in northern Canada is approaching fruition and the oil industry is facing the problem of bringing oil and gas from the North to the markets in southern Canada and the United States of America. So as to be able to mount effective control and guidance of industrial development in the North, the Canadian Government instituted a wide-ranging series of environmental studies (Strang, 1972) in the Mackenzie Valley, the most likely route for a pipeline.

Early in the course of the studies it became apparent that there was a demand for some objective measure of "terrain sensitivity", this term being widely used but lacking rigorous definition. It has been taken here to mean the ability of any site to withstand, or to recover from disturbance. It was hoped that such a rating would enable planners to distinguish readily between those locations where development work could be pursued with little risk to the environment and those which were vulnerable to disturbance.

2.2 Intent

After a reconnaissance in 1971, a small team was assembled by the Canadian Forestry Service to develop a preliminary sensitivity rating for proposed pipeline routes by means of a series of case-history studies. At each point examined, data would be assembled on the disturbed and undisturbed condition and related to the kind and time of disturbance. It was intended that the detailed work of this team would be integrated with the much more extensive land-unit mapping and classifying being carried out by combined groups from the Geological Survey of Canada and the Northern Forest Research Centre of the Canadian Forestry Service and by the Forest Management Research Institute, also of the Canadian Forestry Service (Crampton, 1973; Zoltai and Pettapiece, 1973; Forest Management Research Institute, 1973).

2.3 Correlation with other studies

It was envisaged that the synthesis of detailed site studies with the extensive mapping would make possible reliable predictions of the likely response of any part of the proposed pipeline route to a specific disturbance procedure and would facilitate the identification of the most vulnerable units.

3 CURRENT STATE OF KNOWLEDGE

3.1 Recent literature

Roberts-Pichette (1972) has recently summarized existing knowledge and experience in the vegetation/landform/permafrost aspect of circumpolar ecology. An almost simultaneous monograph (Kerfoot, 1972) deals with recent studies on the Mackenzie Delta in greater detail.

3.2 Areas of work

It is apparent from these works that much more attention has been paid to the lower Mackenzie Valley in, and north of, the boreal forest/tundra ecotone - Brown's (1970) continuous permafrost zone - than in the more southerly, northern boreal or discontinuous and intermittent permafrost zones of the mid- and upper Valley. Unfortunately more of the proposed routes lie in these more variable zones than in the tundra, and extrapolation from one zone to another is unreliable.

3.3 Outline of findings

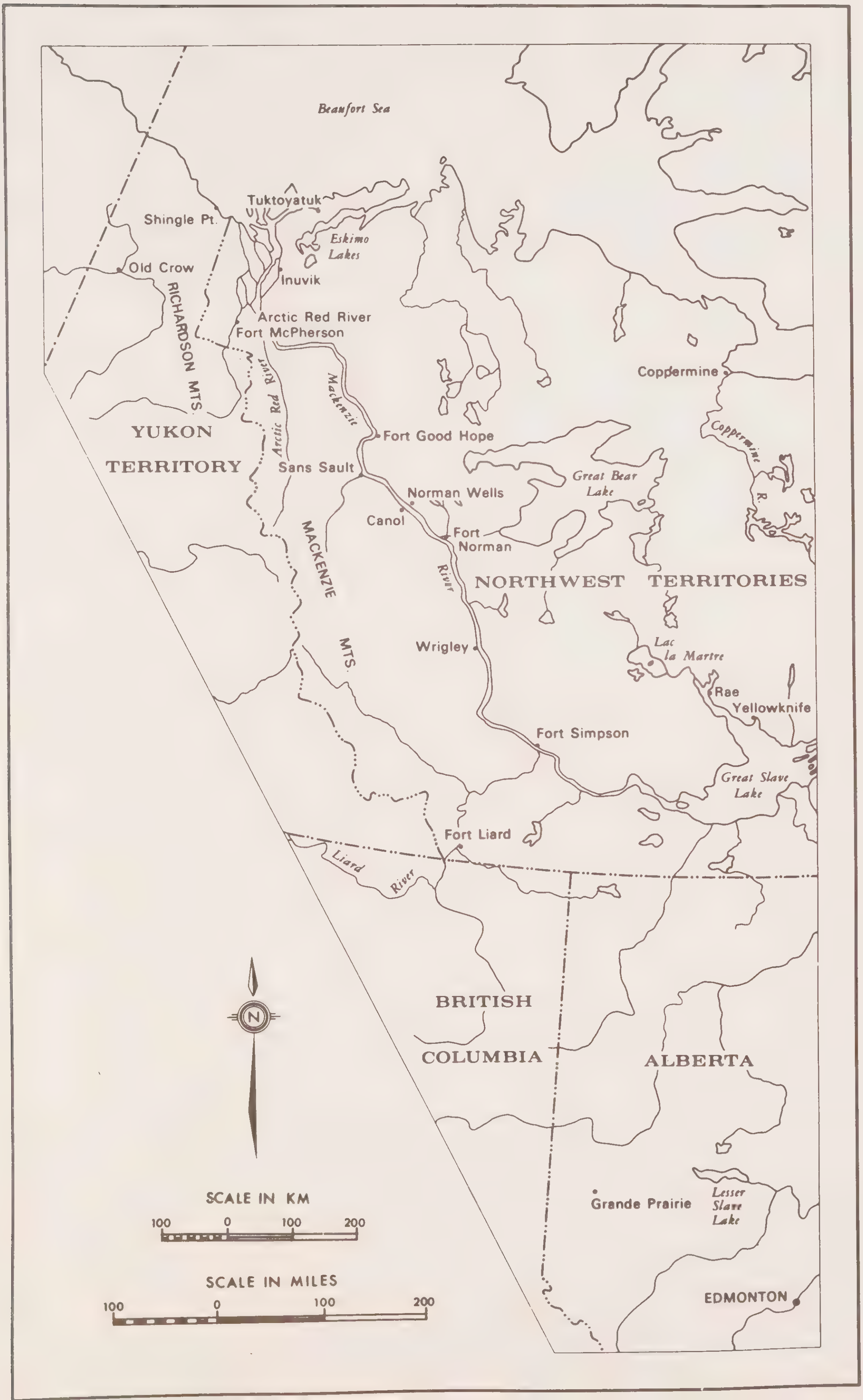
The consensus of opinion is that disturbance results in a lowering of the permafrost table, with a concomitant thickening of the active layer. The extent of consequent thermal erosion is a function of the volume of water present as segregated ice and of local topography, It is not yet possible to identify with certainty sub-surface ice bodies from surface features (Brown, 1965, 1968; Roberts-Pichette, 1972 op. cit. p. 5; Sigafoos, 1950), although, with increasing understanding, this important problem is becoming less intractable (Mackay, 1971).

4 STUDY AREA

4.1 Seven locations close to the expected pipeline and highway routes through the Mackenzie Valley were selected as bases from which to carry out the field programme - Fort Simpson, Wrigley, Fort Norman, Sans Sault Rapids, Fort McPherson and Inuvik in Northwest Territories, and Old Crow in northern Yukon (Fig. 1).

Topographically the area studied lies mostly in Plains Divisions of the northern Interior Plains Region (Anon, 1970) and is of subdued relief apart from the Franklin and Richardson Mountains. It stretches from the southern fringe of the permafrost region, across the zone of widespread permafrost and into the continuous permafrost zone in the north (Brown, 1967) The vegetation is in the upper and lower Mackenzie Sections of the Boreal Forest Region (Rowe, 1959).

Figure 1. Map of Mackenzie River Valley showing study locations.
(Erratum - Tuktoyaktuk is misspelled)



5 METHODS

5.1 Site Selection

From each location, an aerial reconnaissance was flown within an 80 km radius of the camp to locate sites where disturbance had occurred and, particularly, to note where damage had been caused. Twenty to thirty representative sites were chosen to typify the location, care being taken to ensure sampling in all of the more extensive land units now being mapped in the area. In most cases, disturbed sites were seismic lines or well sites but recent burns, slippage slopes and winter roads were also used. Because the intent was to develop a rating of maximum possible damage, sampling was biased towards damage sites and was not representative of any average condition.

5.2 Examination technique

Once a site was selected, a 10 m x 10 m plot was set out in the undisturbed community adjoining the disturbed area. Within the plot, all trees were tallied by species and diameter, stand age was determined from ring counts and height was measured. Understorey and ground cover were assessed in detail along three 10 m line intercepts (Brown, 1954) across the plot. These three lines were extended into the disturbed area where shrubs and ground cover were detailed also. Finally, the intercept lines were continued into the undisturbed area on the opposite side for a third set of measurements (Fig. 2). This was done to establish the homogeneity of the site prior to disturbance. Species lists were compiled as far as possible, with help from Dr. G. W. Argus, National Museum of Science, and from the University of Alberta's Herbarium. Specific identification was not always feasible when only vegetative material could be found. Soil profiles were examined and the mineral horizons sampled for particle size distribution analysis wherever they could be exposed. Soil temperature profiles and depth to permafrost were recorded with thermistor probes and a telethermometer. Soil samples were extracted from the surface of the frozen layer for gravimetric determination of moisture content. Slope angles and the depth of any subsidence in the disturbed areas were measured.

Some 200 sites were measured along the line of the route between June and August 1972.

5.3 Summaries of site descriptions

The observations and recordings made at each site are summarized in Table 1 to 8.

In column 3, latitudes and longitudes are shown to the nearest fifteen seconds. Column 4 gives the appropriate vegetation unit's descriptive symbol as defined by the Forest Management Research Institute (1973). The corresponding identification symbols for the landform units which appear in

column 5 were obtained from the maps produced by Geological Survey of Canada personnel and now on open file*. Column 6 lists Crampton's (1973) corresponding landscape symbols which identify areas of similar vegetation, soil and landscape as far northwards as he surveyed (just south of Fort Good Hope). The G.S.C. and Crampton notations refer to the precise areas studied. Because their maps were, of necessity, drawn to a smaller scale than can show small local variations, some discrepancies may be found between the identifying symbols listed and those drawn on maps of the same area.

Stand composition is outlined in column 7, where maximum, not average, values are given for tree diameter and height at each site. Stocking or stand density, appears large only because all trees were tallied, however small. The ground cover, columns 8 and 15, is identified by the dominant member of each small-scale association recognized. Species lists based on Hultén's (1968) terminology, are available on open file through the Environmental-Social Program, Northern Pipelines, Ottawa.

The terminology of the Canada Department of Agriculture (1970) has been used to describe soil types although the definitions are of doubtful validity in the cryoturbated northern soils (column 9). Texture and pH were determined by standard techniques (Kalra, 1970).

Records of disturbance, columns 12, 13 and 14, were obtained from data filed with the Oils and Minerals Division, Department of Indian Affairs and Northern Development through the good offices of Mr. S. Kanik.

Slope, in column 18, was measured with a clinometer.

5.4 Sampling intensity

It cannot be over-emphasized that this intensity of sampling is inadequate to provide a sensitivity rating of widespread applicability but, within the logistic limits, no more detailed programme could be undertaken. The results must be accepted as no more than an impressionistic first approximation and extrapolation will be fraught with uncertainty.

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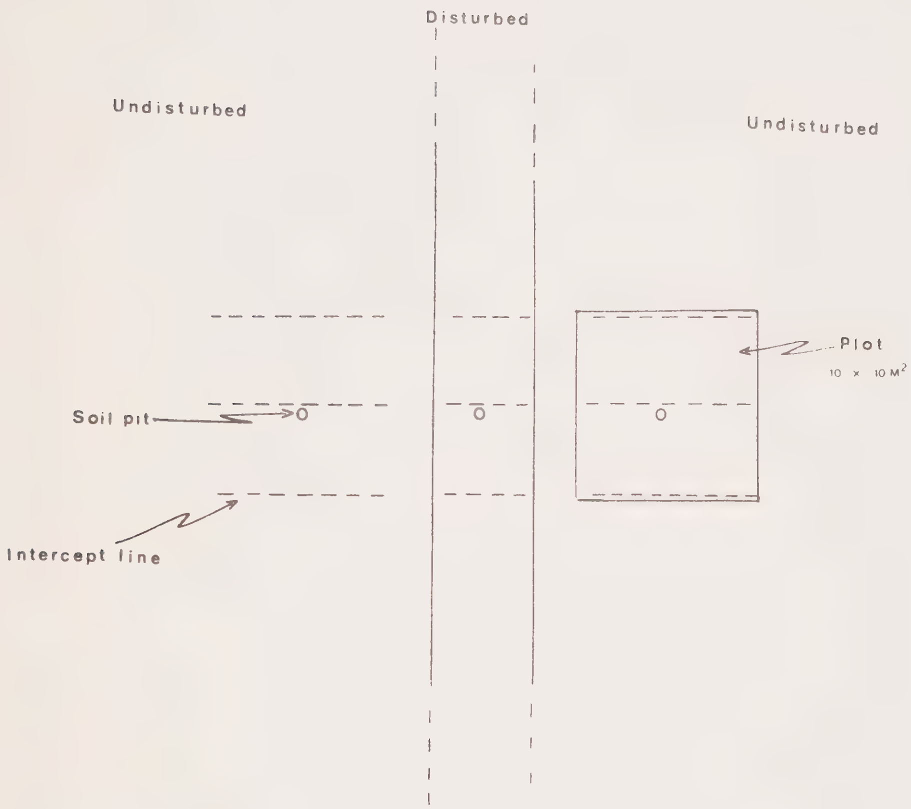
* O.F. 97 obtainable from Riley's Data Share Int. Ltd., 631 - 8th Ave. S.W., Calgary, Alta.

Figure 2. Diagrammatic representation of a disturbed strip and sampling points.



6 RESULTS AND DISCUSSION

6.1 Damage or change

Before discussing the consequences of recent or proposed activities in the Mackenzie Valley, it is essential to differentiate between non-damaging and detrimental changes. Any human interference with a biotic community alters that community to some extent, but not all changes are harmful. For example, to convert rough grazing land into high-yielding pasture by good husbandry is to bring about a significant biological change but not a harmful one. By the same token, we must clarify our thinking about and understanding of, what kinds of environmental change are acceptable along the proposed pipeline route, and what are intolerable. Cutting a seismic line some six metres wide through a decadent black spruce stand on level ground will alter the vegetation in the area cleared - the unthrifty trees and lichens will be replaced by a willow/sedge/cotton grass community with a thickened active layer (Fig. 3). This change will persist for years, possibly decades, but of what harm is it? Some of the earliest bulldozed seismic lines in dwarf birch/ sedge tussock moors have resulted today in shallow trenches supporting a relatively vigorous cotton grass community (Fig. 4). Is this damaging, particularly in view of the proportional area involved? It has unquestionably altered the ecological balance, but to what extent and in what direction?

In this youthful landscape, which is still evolving, one must make a clear distinction between ecological change and environmental harm. The difference was implicit in Churchill and Hanson's (1958) examination of climax in arctic vegetation but it has been largely omitted from more recent discussions about the impact of development in the North. One must also recognize that aesthetic affront is not necessarily synonymous with environmental harm (Strang, 1973b).

In this report, "change" has been deemed damaging only if its effects obviously or continuously extended beyond the area initially disturbed, and it is with this connotation that "damage" has been used. That is, if a disturbance induced only a change in floristic composition, a shallow depression of the ground surface or a slight lowering of the permafrost table it was rated not damaging. More marked effects at the locus of disturbance or an outward spread of the effects of the disturbance - such as accelerated bank erosion, or siltation of a stream bed some distance from the disturbed site - were called harmful. Distinction between harm and no harm and between degrees of severity of damage were subjective and arbitrary.

It must be recognized that the assessments of the effects of disturbance are the results of observations at one point in time. Disturbance may be sufficiently recent that the full effects are not yet apparent and slow, insidious thermal changes may subsequently induce damage in sites presently rated as altered but unharmed.

6.2 Fort Simpson area 1st - 10th July

The effects of artificial disturbance were studied at nineteen sites in the vicinity of Fort Simpson, most of them in Crampton's (1972) Fort Simpson Land Region. At three sites (13, 18 and 19), gully erosion had ensued after seismic lines had been cut; at one of these (18), the gullying was severe (Fig. 5). Extensive and continuing natural slippage was examined on the southern escarpment of the Horn Plateau (Site 15) (Fig. 6). Three sites (10, 11 and 17) had suffered slight surface damage. Disturbances at the remaining twelve sites had caused local changes in vegetation and soil but had not resulted in damage. Natural successional changes were detailed at three undisturbed sites, and at a fourth site recently burned by a lightning fire (Table 1).

At site 13, low on the Horn Plateau escarpment, a seismic line had been cut in a mixed *Picea/Betula/Populus* wood on a 30% slope on shallow loamy soil over shale - an orthic dystric brunisol. The cut line has intersected a natural seepage line with consequent gullying to 0.7 m. Site 18, also in a mixed wood, was on a high-ice-content cryic gleysol, with a 5% slope towards the Martin River. It appeared that some gully erosion had developed from a seismic line and that the conventional, southern, remedial technique of smoothing off the slopes had been applied. This had not been successful and the main gully was almost 2.0 m deep at the time of measurement. Surface water movement along a seismic line was widening and deepening an existing water course through an *Alnus* thicket on the Martin Hills east scarp (Site 19) where the line crossed the stream bed. The soil was a silty orthic dystric brunisol on a slope varying from 6 to 20%.

The natural slippage area on the Horn escarpment (Site 15) was characterized by a 50 cm organic layer over a coarse gravelly sandy clay. The active head wall had cut back into a seepage zone on the plateau surface. The debris at the toe of the slope had stabilized and had *Picea glauca* trees up to 100 years old.

The sites which had been altered but not severely damaged were either dry, site 7 for example, or were on level ground so that disturbance had simply caused a depression of the surface *in situ*, and an increase in local soil moisture as the active layer deepened.

The common element in the sites suffering damage was an increase in moving water. At sites 13 and 19 this was simply the consequence of altered drainage patterns. At sites 18 and 15, thawing of sub-surface ice had aggravated the mechanical erosion problem caused by water flowing in an unstable channel. In this area, because damage is largely a mechanical erosion problem, slope is more important than soil composition.

6.3 Wrigley area 12th - 22nd June

In the twenty-seven sites examined in the Wrigley area, mostly in Crampton's (1972) Land Region 3, very severe damage was observed at two sites, four sites were suffering less severe damage, slight damage was evident at two sites and the remaining nineteen were virtually unharmed. In addition, the sides of a small creek flowing into the Mackenzie River were examined where extensive natural slippage and subsequent restabilization were apparent (Table 2).

The most severe and widespread damage had been caused near the Dahadinni River on the west bank of the Mackenzie River (sites 47 and 49) (Fig. 7). Here, tracked vehicles had traversed the area in the spring of 1970, after thawing, in an area of stagnant *Picea mariana* and *Larix laricina* with gentle slopes, not more than 10%, and a deep organic soil. The result was a deeply rutted tract some 280 m wide (site 47), and a gully more than 4 m deep (site 49) where a trackway had widened to incorporate an existing water channel parallel to it. The extent of the disturbed area was a result of the vehicles making successive sub-parallel new paths as existing ones became impassable quagmires. Immediately adjoining and downslope from the site 47 area, the vehicles had crossed a wet fen (site 48) which had not been damaged. It is believed that the fen was still frozen or snow-covered at the time of travel.

Gully erosion was progressing steadily in unprotected roadways at sites 37 and 42. Site 37 was in an area of unthrifty *Picea mariana* and *Larix laricina* on a cryic gleysol where a seismic line had intersected several small watercourses. Site 42 was a recently-made road cutting diagonally across an 8-12% slope through a mixed wood on an orthic dystric brunisol. Surface erosion was also in progress at sites 31 and 50 where a winter road and a seismic line, respectively, had been cut to the edges of steep banks. Site 31 was an alluvial regosol on the bank of Willowlake River, and site 50 was an orthic gleysol on a high bank above the Redstone River (Fig. 8). Slight gully or rill erosion was noted at site 27, a rego-gleysol on a 10% slope, and at site 40, an orthic humic gleysol on a 5% slope. The remaining sites were undamaged, although changes in vegetation, slight surface depression and some accumulation of water had developed.

As in the Fort Simpson area, the problem was one of mechanical rather than thermal erosion and, apart from site 47, damage was associated with water moving across a disturbed surface. The undamaged sites were on flat or only slightly sloping ground. The increasingly frequent occurrence of permafrost from south to north provided an additional source of water if the frozen ground were exposed to thawing, as at site 49, but the first damaging response to disturbance was mechanical erosion.

Examination of a slippage bank with a 75% slope showed that massive soil movement had taken place, although the ground cover - 100% feather mosses under mature *Picea glauca* - had not been disturbed. The soil, a deep cryic dystric brunisol, had 40 cm of porous gravelly sand overlying very fine sand and silt. At the interface there was a layer of almost pure ice. The moisture content of the upper soil horizon was 13%, and of the lower stratum, 23%. As the ice melted, water percolated downwards through the permeable, upper horizon, until its movement was impeded by the fine-textured material, above which it accumulated and where, presumably, it acted as the "lubricant" which caused

slippage. Once the discontinuity had been removed there would be no local accumulation of water and so stability would be restored.

6.4 Fort Norman area. 9th to 24th July.

Twenty-two sites were studied in the area of Fort Norman. Six sites were on the Canol Road and one in a recent burn. Of the rest, serious damage was recorded at five sites, lesser harm at one other and nine were apparently undamaged. (Table 3).

The Canol Road sites were on the plain between the west bank of the Mackenzie River and the Mackenzie Mountains. No environmental harm was apparent, nor had the road deteriorated badly during almost 30 years of neglect, except for washed-out culverts (Fig. 9) and destruction of the road in the Dodo canyon by extensive wash-outs (site 60). The road had been built on a coarse aggregate berm 1-½ m. thick.

At site 52, on the west bank of the River, damage was similar to that at site 47, though less extensive. Frequent travel between a well site and the river bank across unfrozen ground had caused rutting over a wide area and some active gully erosion. Site 53 was an example, like site 18, of the dangers of misapplying southern, earth-working techniques in a permafrost environment. An attempt had been made to halt incipient gully erosion in a winter road down the bank of a small creek. Reducing the slope angle by bulldozing had increased the area of exposed mineral soil--a cryic orthic gleysol (with interbedded loam and sand strata) over shale--adding thermal erosion effects to the existing mechanical ones. The result was a gully presently 2.5 m deep and still increasing. The aspect of this slope was easterly. On the opposite, west-facing bank, the soil was a degraded dystric brunisol and no erosion was seen. At site 61 the east-facing bank of a creek was being badly eroded where a seismic line had been cut on a 10-15% slope. The soil-a cryic dystric brunisol - has a series of alternating strata of sand and silt between 7 and 100 cm (Figs. 11 and 12). The west-facing bank, of more uniform composition, was suffering only surface rill erosion. Damage at Site 65 on the east bank of the Mackenzie was being caused where a seismic line had crossed the crest of the bank and intersected two water channels in a cryic gleysol (Fig. 10). There was a resulting gully 3 m deep in the lower part of the cut line. Deepening of an existing water channel by accelerated erosion (following the clearing of a seismic line along the channel which leads to the Great Bear River) had drained a small pond at site 69. A subsequent fire had worsened the appearance of devastation, but it was questionable whether real damage had been caused or whether a natural change had merely been accelerated.

At site 68, a cryic gleysol, some slight damage had been caused by vehicular traffic over unfrozen ground which had necessitated the creation of a succession of parallel new tracks as each one became impassably muddy. The site being level; no erosion was taking place.

At the nine other sites, the expected changes--a lowering of the permafrost table, a depression of the ground surface, an increase in surface water and the ecesis of more mesophytic vegetation such as *Eriophorum* spp. and *Carex* spp.-- were noted, but no damage could be detected.

6.4 As in the Wrigley area, the prime damaging agent was mechanical erosion, but in this more northerly region, concomitant thermal erosion was seen to be an increasingly important factor. The vulnerability of soils with a permeable layer overlying an impermeable one also became more apparent. The effects of aspect on soil characteristics and stability were becoming more prominent. East-facing and therefore cool slopes were more subject to erosion than west-facing slopes which, being warmer, had less ice and a deeper active layer, so that thermal erosion was of smaller magnitude.

The stability of the hastily-built Canol road was striking. It was noteworthy that the road had been built up above the ground level and no cuttings had been excavated in the plain between the mountains and the Mackenzie River.

6.5 Sans Sault Rapids area. 10th - 14th July.

Seventeen sites were studied in the area of the confluence of the Mountain and Mackenzie Rivers at Sans Sault Rapids. Severe damage was recorded at five sites, slight damage at three and negligible or no damage at the remaining nine (Table 4).

At two of the severly damaged sites where deep gullying was developing, (76 and 84), the soils were dry and sandy and so there was only a mechanical erosion problem. Two seismic lines at right angles in a shallow cryic regosol, (Site 87), were deeply eroded down to shale bedrock at 1.5 m, although slopes were less than 4%, and water was flowing freely in the deeper of the two lines. Site 88 was yet another example of multiple tracks caused by vehicle movement on unfrozen ground. A strip of about 70m wide had been churned up on both dry and wet cryic gleysols by repeated, parallel vehicle passes. Because the slopes were gentle, less than 4%, little soil movement had taken place. Massive slippage was developing at Site 90 where a seismic line had been cut across a steep-sided gully. The soil was a shallow cryic dystric brunisol with a high-ice-content permafrost at 30 cm and the gully was steadily enlarging so that the seismic line would soon be completely cut.

Mechanical and thermal erosion on unconsolidated shaly soil was evident on a 1-10% slope where a seismic line had been cut directly across the contours at Site 75. More extensive slippage was developing in a recently burned tract close to the seismic line where the upper horizons were moving over the melting surface of the permafrost stratum. Summer travel on a level cryic gleysol (Site 77) had caused extensive shallow rutting and churning, but no soil movement. At Site 80, in a well-drained orthic dystric brunisol, a large slump hole was forming in a winter road. The locality was dry and no explanation for the slumping was immediately apparent.

In the nine sites rated as undamaged the amount of depression or settlement of the disturbed surface was more than had been experienced further south--a reflection of the more widespread permafrost, thinner active layer and relatively greater ice content. At site 74, in particular, in wet cryic regosol land with stagnant *Picea mariana* and *Larix laricina*, small thermokarst holes were developing in the seismic line. Although this was not yet damage, as defined here, the effects of disturbance might extend with time until real harm was being caused.

6.6 Fort Good Hope area. 14th - 20th July.

Much of the Fort Good Hope area east of the Mackenzie River has been burned within the last decade or so and fires have been extensive on the west bank also although the area, being of subdued relief, was generally wet and poorly drained. Few old, undisturbed stands were to be found. Fifteen sites were examined. Severe damage was noted at two sites, slight damage at one and twelve were altered but not harmed. (Table 5).

The most extensive apparent damage and, again, this term must be used circumspectly, was an area of natural slippage on the Hume River banks (Site 101). The causal factors could not be identified as the mature *Picea glauca* wood above the bank was intact. The soil was a silty-clay, cryic gleysol with a high-ice-content permafrost stratum. The debris at the toe of the slope was dry and stable. Anthropogenic damage was obvious at Site 104 where summer traffic had cut deep ruts into an orthic humic gleysol in a level terrace on the Mackenzie River Bank. Water spilling from these ruts into a small stream was causing rapid erosion of the stream banks. Less severe harm was recorded at Site 97 on a steep, 30% slope, section of a winter road in an orthic dystric brunisol. Surface washing had eroded ruts to 60 cm. The active layer in the roadway had been deepened to more than 65 cm - it was about 20 cm in the surrounding woodland - and so no thermal erosion was taking place.

Changes in soil and vegetation were obvious in the other twelve sites but no significant damage was noted. The flatness of the terrain was one reason for this and, as fires lower the permafrost table and deepen the active layer, the likelihood of thermal erosion was small in the disturbed *brulé*.

6.7 Fort McPherson area. 21st - 4th August.

The country side around Fort McPherson is divided into three ecologically and physiographically distinct units - the flat, poorly-drained northwestern end of the Mackenzie Plain between the Peel and Arctic Red Rivers; the undulating, deeply-incised eastern foothills of the Richardson Mountains rising westwards from the Peel River, and the Delta to the north. Only the first two were examined at this time, delta sites being dealt with later from Inuvik (Table 6).

Fifteen sites were studied in the Mackenzie Plain area. Severe damage was apparent at three sites, moderate damage was noted once and slight damage was recorded twice. The nine other sites had undergone varying degrees of change but were deemed to be unharmed.

At Site 126, with a cryic-gleysol of very sticky, intractable clay, erosion had cut a gully some 2 m deep where a seismic line angled across a 12% northeasternly slope. With only a shallow active layer over frozen ground, a flow-slide was developing. Several active flow-slides had been initiated where road construction on the Dempster Highway had excavated a cutting through a low knoll with massive, segregated ice-bodies close to the surface (Site 127) (Fig. 13). From the cut banks it appeared that the collapsing slides were associated with ice-rich soils, while the stretches of comparatively stable banks between flow-slides, being gravelly, had much less ice although there were no obvious surface differences. Also associated with the Highway (Site 129), an active flow-slide was cutting back into an undisturbed mixed wood

from a gravel borrow-pit. The head wall had cut back 12 m between the onset of thawing in spring 1972 and measurement in late July of the same year.

Ruts about 0.5 m deep had formed in a level cryic regosol (Site 128) where a stabilized seismic line had subsequently been used for summer travel alongside the highway. The ruts appeared to be unstable with slow water movement. Damage was apparent on a gentle southeasterly slope where a seismic line through a stagnant *Picea mariana* stand on a cryic gleysol had caused some rutting (Site 113) (Fig. 14), and ruts were beginning to form in a 7% south-easterly slope at Site 134 where two seismic lines intersected.

Settling of the surface, melting of the uppermost surface of the frozen ground and the replacement of the moss, lichen or low shrub ground cover by an *Eriophorum* sp. or *Carex* sp. vegetation were always apparent in the other disturbed areas but, as these were not spreading, the sites were judged to be unharmed.

In the foothills, fourteen sites were studied and eleven of these were deemed to be unharmed, slight damage was evident at two sites and severe damage was reported at one.

The severely damaged site (124) was an early seismic line which had been deeply bulldozed at the time of clearing across a level stretch of land with scattered trees over sedge/heath tussocks. A 2 m deep rut in the centre of the seismic line had not breached any water course, but deep thermokarst sink holes in the road suggested that the line had not yet restabilized (Fig. 15). The soil was a cryic gleysol with a gravel stratum at about 2m. It was conjectured that meltwater was moving away through this permeable stratum and allowing degradation to continue but there was no surface indicator to forewarn of this possibility.

Moderate damage at Site 120 showed the effects of slope on susceptibilit to damage. A recent shallow seismic line was barely discernible over *Betula glandulosa*/heath hummocky ground on a level terrace (Fig. 16). A short distance away, on a 24%, westerly slope, the same line had caused erosion to 1 m and exposed the siltstone parent material (Fig. 17). Thermokarst depressions were reaching sizable dimension at site 123 where the general level of settling was not severe.

At Site 122 the vulnerability of restabilized sites could be seen. An old seismic line, in which grasses, *Carex* spp. and *Eriophorum* spp. had re-established a complete cover after the initial disturbance on level ground, had recently been used again in the summer season. Wet ruts were forming, the secondary vegetation was crushed and trampled and thermal erosion were beginning to cause relatively deep thermokarst holes in the line.

Site 117 was anomalous in being apparently undamaged despite the clearing of a seismic line on a 25% slope. The explanation was not immediately apparent.

Despite the irregular topography and the shallowness of the active layer, the remaining eleven sites were not harmed. In the earliest lines, which had been bulldozed, settlement was quite deep, as much as 75 cm or

more (site 110) but conditions were stable. The more recent lines, which were merely scuffed, had caused very little change at all.

6.8 Old Crow area. 5 - 12 August.

Sixteen sites were examined in the vicinity of Old Crow in northern Yukon. Three instances of quite severe damage by man and one natural damaging phenomenon were recorded. Five cases of slight damage were observed and seven sites were unharmed. (Table 7).

At Site 146, ruts about 0.5 m deep had developed in a summer seismic line cutting through a black spruce stand on a 12-14% north slope. An adjacent winter line had caused very little harm. Site 147 was also rutted to about 0.5 m on a 20-25% slope following seismic clearing. Damage was similar on both sides of a gully indicating that, in this area, aspect was of little importance in determining the consequences of disturbance. Severe and continuing damage was apparent on the south bank of the Porcupine River where frequent travelling on the lowest terrace had created gullies about 1 m deep (Site 149). The natural damage, Site 140, was apparently due to the discharge of sulphur-rich water from the bottom of a small hill following burning. Vegetation was dead or dying in several long strips and, with continued water seepage, deep gullies were forming in the bared areas. The source of the sulphur was not identified.

Some thermokarst degradation of a shallow seismic line through an over-mature spruce stand was seen at Site 135. Shallow rutting in a birch fen on level alluvium at the junction of the Porcupine and Old Crow rivers, Site 136, had created extremely wet conditions but no soil movement. At Site 137 also, shallow rutting had followed the cutting of a seismic line through a decadent black spruce stand on an organic soil. Damage was widespread but not severe at Site 144 and 145 where summer traffic by tracked vehicles had caused many shallow ruts in a cryic gleysol. At Site 145 the width of the disturbed area was 60 m. Shallow ruts had developed in a cryic gleysol of dense clay through a stagnant black spruce/alder community, Site 148. The site was level and no soil movement was observed.

The general impression of the Old Crow area was of little harm, probably because of careful operating. The areas of noteworthy damage were nowhere extensive.

6.9 Inuvik area. August 14 - 31.

From Inuvik, three ecological zones were examined. Twenty-one sites were studied in the northern limits of the boreal forest south of Inuvik, sixteen in the low elevation, Arctic tundra northeastwards towards the coast and seven in the upland tundra of the northern Richardson foothills. These last were similar to the foothills sites studied from Fort McPherson further southwards (Table 8).

Of the boreal forest sites, five were rated as severely harmed and five others as moderately damaged. The remaining eleven were judged to be only slightly damaged if at all.

At Site 151, summer travel in a gully on the east bank of the Mackenzie River near Arctic Red River had deepened the water channel by 1.5m and active erosion in the stream bed was evident (Fig. 18). A second, though less drastic, instance was at Pierre Creek a few kilometres to the east (Site 189). Here, mechanical and thermal erosion in an access road up a small valley sloping at 15% had resulted in a gully 1 m deep, while above the bank, with similar soil, the road was rutted to only a few centimeters. Site 194 on the east bank of the Arctic Red River was yet another example of the same effect. Here a two-metre deepening of an existing water channel had followed the cutting of a seismic line in a cryic brunisol. The two other severely damaged sites (186, 187) were in the area of the Inuvik burn where fire breaks and access roads constructed during fire-fighting operations there in 1968 were already severely eroded. (Fig. 19). The effects of this fire are being studied in detail (Heginbottom, 1971) and have been cited and discussed with some frequency.

Moderate damage was apparent at five sites altered by very recent traffic in connection with highway construction, sites 154, 161, 162, 163, 165. Slopes varied between level and 12% and the soil was a cryic regosol. Ruts and small thermokarst holes were no more than 50 cm deep but they may well increase with the passage of time. The fifth moderate damage case was older, in a seismic line cleared through a wet hollow with a "drunken forest" (Benninghoff, 1952) of *Picea mariana* (Site 191). Several thermokarst holes 60-80 cm deep had developed in a poorly-drained cryic regosol. The surrounding drier site, on well-drained brunisol, was unharmed.

At the other sites, the changes induced by clearing for seismic lines at well sites or by burning had not extended beyond the treated area and so were judged to be not harmful.

Only two of the Arctic tundra sites were reported as severely damaged and five were moderately harmed.

Damage at Site 160, a pond in the Caribou Hills, was natural. After burning in 1969, extensive thermal erosion, bank slippage and flow sliding was taking place where re-stabilization after a previous fire, perhaps 50 years ago, was not long established, with lichens and 25-years-old *Alnus incana* shrubs prominent. The man-caused harm was at Site 179 where a seismic line on a 14% north slope had eroded about 1 m after bulldozing had exposed the mineral soil. An adjacent, shallower line was apparently stable.

Four moderately damaged sites were in the area west of Eskimo Lakes (181, 182, 185, 188). Removal of most of the active layer had resulted in ruts 50-80 cm deep along seismic lines, and some thermokarst ponding at Site 182 where a winter landing strip had been scraped smooth. The sites being more or less level, no soil or water movement was apparent. At the fifth site to sustain moderate damage (177), a seismic line had been prepared by bulldozing. Consequent thermal erosion had created a deep wet gully or trench.

In the ten unharmed sites, shallow clearing had scraped off the tops of mounds, caused an increase in the proportions of *Carex* spp. and *Eriophorum* spp., some settlement but no evident soil movement (Fig. 20).

Of the foothills sites, only three showed some damage; the others had suffered little or no damage.

At Sites 160, 167 and 169 seismic lines had been excavated to shallow depth and subsequent thermal settlement had lowered the ground surface about 50 cm. In all cases some of the organic layer had been left intact and some had been incorporated into the uppermost mineral soil. Slopes were not more than 7% and no soil movement was noted.

The five other sites were quite uniform with *Carex/Eriophorum* spp. communities in shallow ruts replacing the mixed communities of the undisturbed vegetation. The seismic lines were shallow and recent and, even where they crossed frost polygon areas, little harm was apparent. In some cases vehicle tracks were discerned only with difficulty.

6.10 Soil Temperature Data and Permafrost

6.10.1 During the first weeks of the field season only seasonal frost levels could be determined, not the permafrost level, and so the data collected then were of limited value. In almost all cases where there were large differences between the thicknesses of the unfrozen layers under disturbed and undisturbed surfaces, both the vegetation and the organic horizons had been cleared off. At Site 53, where disturbance had been irregular, the difference between depth to frost under bared soil (> 100 cm) and under residual humus (40 cm) was striking. Sites 85 and 89 also exemplified the effects of retaining an organic cover on the soil thermal regime. There were two unexplained exceptions, sites 36 and 56, where the depth to frost was noticeably greater under the disturbed surface than under the undisturbed despite the persistence of a good plant and humus cover after disturbance.

6.10.2 Those disturbances which resulted in the ponding of an appreciable extent of water on the surface, sites 87 and 88 for example, caused a rapid thawing of the uppermost strata in the same way as did bare mineral soil.

6.10.3 The data recorded at Fort Good Hope and further northwards did reflect the permafrost condition or something approaching it closely.

6.10.4 Around Fort Good Hope there was a wide variation in the amount of depression of the permafrost table following disturbance. The larger differences between undisturbed and disturbed conditions were always associated with either removal of a large proportion of organic matter or with increased wetness at the disturbed surface.

6.10.5 The land between Yeltea Lake and the Mackenzie River, an area of subdued relief and abundant soil moisture had an uncommonly uniform and deep permafrost table with an active layer about 100 cm thick. Beneath a 10-12 cm surficial organic stratum there were 70 cm of silt or silty clay resting on a gravelly seam 20 cm thick. This was underlain by a massive, impermeable gleyed horizon. The relatively deep active layer was not reflected in a noticeably more rigorous plant cover. It is suspected that the thin organic mantle and high thermal conductivity of the wet silt are responsible for the depth of the active layer. Heat transfer by moisture moving through the silt and gravel horizons may also be a causal factor.

6.10.5 Further northwestwards, in the Mackenzie Plain, the permafrost table varied from 20 to 60 cm. On the average, surface disturbance increased active layer thickness by 23 cm, the more extreme increases being associated with reduction in the extent of the organic layer. At Site 127, on the newly constructed Dempster Highway marked differences were found between the ice content of stable and unstable cut banks. In soil pits dug just behind the stable banks, less than 10% of the vertical faces was occupied by segregated ice. Such ice as did occur was in widely dispersed, small lenses not more than 3 cm by 3 mm. In contrast, it was estimated that 70 percent of the upper 1.5 m of the vertical headwall of one mudflow slide was segregated ice.

6.10.6 The clayey soils of the Peel Plateau were characteristically cryoturbated with many hummocks and frost boils, some of which were undergoing active wind erosion. The frost table was a mirror image of the surface profile with 40 - 60 cm to permafrost below mounds and 0 - 20 cm to permafrost, often an ice wedge, in the interstices between mounds. Following disturbance the average increase in depth to permafrost was 21 cm but this increase was often masked by changes in surface level.

6.10.7 The average increase in active layer thickness in the Old Crow area was about 10 cm from an undisturbed thickness of 50 to 60 cm. The soils were mostly unglaciated silt or clay lacustrine deposits with a relatively thin organic layer and were stable.

6.10.8 The Arctic tundra north of Inuvik had, like the Peel Plateau, an undulating permafrost table below a mounded or hummocky surface with an active layer 30 - 45 cm thick below mounds. Cryoturbation activity was apparent. Site 177 afforded an example of the ill effects of undue disturbance to the protective surface humus layer. In a deeply excavated seismic line the surface had been lowered 65 to 70 cm and the thickness of the active layer had been increased by one third, from 30 to 40 cm. At Site 179 parallel surface travel and excavated seismic lines also pointed up the damage caused by surface disturbance. A seismic line bulldozed five years ago had degenerated into a gully 1 m deep with 90 cm of thawed soil above the permafrost. More recent winter travel alongside the gully has depressed the surface 15 cm and has slightly reduced the thickness of the active layer from 45 (±5) cm to 40 cm.

6.10.9 A 10 cm gravel berm was quite inadequate to preserve the permafrost level (site 180). In one season the active layer had thickened from 30 to 55 cm after the gravel had been spread on top of the lightly scuffed organic layer. Presumably the higher albedo of the gravel in contrast to the intact vegetation/humus cover was responsible for this 83% increase.

7 SUMMATION.

7.1 Causes of serious damage.

7.11 The two most common causes of serious damage were the exposure of subsurface ice or frozen soil on sloping ground and the intersection and diversion of drainage channels.

7.12 A combination of thermal and mechanical erosion was the continuing and accelerating consequence of any disturbance which removed the vegetation and organic layers on slopes steeper than 5%. Thawing at the permafrost surface produced an unstable mud or soil/water mix, which moved down slope exposing more frozen material to thawing, and so on in a self-sustaining process. A cutting on the Dempster highway west of Arctic Red River illustrated this phenomenon most dramatically. On slopes of less than 5%, the thawed material tended to remain in place so that deeper frozen layers were not exposed to the same intensity of thawing as on slopes.

7.13 Intersection of water courses was the second most common cause of serious harm, and it was also a commonly-recorded cause of moderate damage. The sequence appeared to be initial mechanical erosion eventually exposing frozen material to thawing and gravitational removal leading to continuing erosion.

7.2 Travel on unfrozen ground and re-stabilizing communities.

7.21 Frequent travel on unfrozen wet or poorly drained soils, particularly cryic gleysols, had caused damage at several widely separated locations. The damage was extensive rather than intensive but in at least two instances it had spread outwards to intersect drainage channels, diverting streams, causing severe gully erosion and killing vegetation in discharge areas.

7.22 Serious damage resulted from re-use of stabilizing old roads or seismic lines. The wet soil and re-colonizing vegetation, including *Carex* spp., *Eriophorum* ssp. *Ranunculus gmelini* and *Petasites* spp., seemed to be very intolerant of disturbance, so that a second round of disturbance was causing severe degradation.

7.3 Mechanical erosion.

Simple mechanical erosion was found in dry, unconsolidated, light-textured soils at six sites, all south of Fort Good Hope. Permafrost was sufficiently common north of Fort Good Hope that all observed mechanical erosion was complicated by thermal erosion.

7.4 Interbedded soils.

Soil in which a coarse, permeable horizon overlay an impermeable stratum, whether of fine mineral matter or bedrock, was unstable under natural conditions and even more so if the surface of a slope of such composition was disturbed. Many natural slippage areas were of this kind and disturbance in soils with such a profile produced some striking and unfortunate consequences.

7.5 Correlation with mapping units.

By comparing the site descriptions summarized in Tables 1-8 with the landform or vegetation type units described by Crampton, Wallace and Zoltai in this group of reports (columns 4, 5 and 6 in the Tables), one can infer the likely response of any areal unit to a particular kind of disturbance.

7.6 Inapplicability of southern techniques.

Conventional, southern techniques of controlling accelerated erosion by massive earthworks are invalid in the permafrost environment. Their use is likely to aggravate rather than control the problem.

7.7 Permafrost, frozen soil and stability

It is common knowledge that it is the frozen strata which confer stability on northern soils and that continuation of the frozen state is the key to preservation of stability. Exposing frozen soil or ice to the atmosphere will, fairly obviously, set off the thawing process, but sub-surface thawing will begin if the soil is altered to bring about a positive heat balance below the surface. This will happen if the organic layer is removed or if the site is altered to induce ponding of water at the surface. Removal of only living vegetation leaving the dead organic mantle intact results in very little thermal erosion. This suggests that the organic layer is much more important than live plants in maintaining a negative heat balance in the soil.

Maintenance of the snow cover will delay the onset of thawing and help to maintain the frozen state. There is a deeper active layer on the treeless, open Richardson foothills where wind reduces the depth of snow cover than in the lower Mackenzie Plain where snow accumulates and persists under the diffuse cover of trees and shrubs.

7.8 Effects of Fire.

No special study of fire and its effects was attempted but a few sites where adjoining burned and unburned sites could be compared were examined. These indicated that, in both the Arctic tundra and in the boreal forest of the upper Mackenzie, burning induced no lasting change in stand composition, merely setting the succession back to an early seral stage from which it developed again towards the composition which had been present before burning. There was a temporary increase in the thickness of the active layer and a reduction of surface irregularities due to a lowering of the permafrost table. This suggested that there may be a place for controlled burning in particular sites as a site preparation before carrying out surface earth-working. In the northern limits of the boreal forest, the ecotone between forest and tundra, fire stimulated a relatively more vigorous tree stand and, conversely, a freedom from burning promoted the development of a stagnating, "drunken" forest and, eventually the replacement of an open tree stand by a treeless lichen tundra (Strang, 1973a).

7.9 Mud flow-slides

Seven mud flow-slides were examined. In four, (Sites 43, 101, 160 and one unnumbered) there was good evidence that the slides had developed soon after burning, and other instances of this sequence were apparent particularly on the east bank of the Mackenzie River in the Little Chicago area. One set of conspicuously active slides was the result of road excavation through a small hillock (Site 127) and the remaining two (Sites 15 and Wrigley unnumbered) were on banks with intact mature stands on the crests where the cause of sliding was not immediately apparent. In each case, soils with large amounts of segregated ice had been exposed to thawing by some extraneous action which had initiated the flow-slides.

A few instances of old re-established slides were seen but it was not possible to say how equilibrium had been restored. A succession of cold summers, removal of all of the ice, shading of the melting headwall or a combination of these circumstances must have been involved.

Interbedded soils with alternating coarse and fine-textured material seemed especially vulnerable to failure. Accumulations of ice at the interface between an upper, freely-draining stratum and a lower partially impermeable stratum were apparently the lines of weakness.

7.10 Extrapolation.

The general recommendations which follow are probably applicable to other similar northern areas, but it would be rash to extrapolate in detail from these sites to others without prior careful observation and examination of the new sites.

8 CONCLUSIONS.

8.1 Inappropriateness of terrain sensitivity rating.

No general terrain sensitivity rating could be derived from these case histories and it is doubtful if any system valid at more than a general level is possible. There are three reasons for this. Firstly, there are considerable point-to-point variations in micro-site, particularly slope, aspect and sub-surface moisture, all of which produce different responses to any disturbance. Secondly, seasonal effects have an important bearing on response, and three "states" or "conditions" can be recognized corresponding to the seasonal weather changes (a) the frozen state, in winter, the least vulnerable, (b) the thawing state, in spring, the most vulnerable, and (c) the relatively dry state, in summer, intermediate in vulnerability between (a) and (b). Lastly, the kinds of disturbance possible are many and the differences in intensity almost infinite. All of these factors militate strongly against the production of a useful sensitivity rating.

8.2 Limited value of generalities.

Some broad generalizations are possible but they are of limited value and, in the interests of environmental stability, each proposed disturbance treatment requires detailed individual study.

8.3 Most vulnerable sites.

The most vulnerable sites are those with ice-rich strata close to the surface. Any treatment which exposes icy strata to melting is potentially hazardous, particularly where slopes exceed 5%.

8.4 Importance of the organic layer.

The most important natural agent in maintaining a negative heat balance in the soil, and thereby preserving stability, is the surficial layer of organic material. In general, treatments which destroy or remove the organic layer cause damage, while those which leave the layer more or less intact induce change but do not cause harm.

8.5 Importance of water courses.

All water courses, of whatever size, are potential sources of instability if disturbed. Streams, creeks and rivulets are easily identified, but it is important to be aware of and to consider minor seepage lines also (Fig. 21).

8.6 Vulnerability of re-stabilizing sites.

A site being recolonized after slight disturbance is very vulnerable to further disturbance during the early years of recolonization.

8.7 Surface disturbance during thawing season.

The thaw season is the most dangerous time, for a combination of biological and human reasons. Surface disturbance of a thawing wet soil quickly churns the humus into mixture with the underlying mineral soil so that the

insulating value of the organic layer is lost. The altered thermal balance leads to melting at the permafrost table and consequent erosion. If traffic continues on a level site, any one track quickly becomes impassably muddy and a new track, soon to be reduced to a similar state, is opened to one side. Damage can thus be intensive, extensive or both.

8.8 Effects of burning.

Burning is a natural environmental factor. It results in a temporary lowering of the frost table and checks natural succession towards a climax vegetation community.

8.9 Control of accelerated erosion.

Where accelerated erosion is caused, the control techniques used must be environmentally appropriate.

8.10 Critical angle of slope.

The angle of slope at which accelerated erosion becomes noticeable is between 5% and 10% and so, for practical purposes, 5% should be taken as the critical limit.

9 RECOMMENDATIONS

9.1 General

9.11 Because of the inadequacy of general statements or descriptions and their inability to cover all of the many variations likely to be encountered, proposals for any activity must be well prepared, in detail. Sufficient time must be allowed after proposals are submitted to permit a thorough examination and evaluation of the proposed activity before it is started.

9.12 All ice-rich soils must be treated with extreme care.

9.13 During and immediately after the period of active thawing, movement on the ground must be restricted to foot travel or to vehicles which will not scar the ground surface.

9.14 At any time when uncertainty exists about the consequences of a proposed activity, that activity must be halted until it can be shown to be not damaging - to use an aphorism "when in doubt - don't".

9.2 Specific

9.21 When it is known or suspected that underground ice bodies occur, their size and position should be determined by coring before cutting or excavation is carried out.

9.22 Removal of the living vegetation is permissible but destruction of the surficial organic layer cannot be allowed in spring or summer. It may be removed or destroyed during the winter months, providing always that, before the onset of thawing conditions, it is replaced by an insulating layer having thermal characteristics equivalent to those of the organic layer.

9.23 Particular care must be exercised at all crossings of water courses. runnels and drainage channels to avoid either ponding or concentrating the flow into a rapid stream capable of causing erosion.

9.24 All slopes steeper than 5% must be regarded as susceptible to accelerated erosion. Preventive measures should be required on all such slopes but they must be of such a nature that they do not aggravate the situation they are intended to remedy.

9.3 Opinion

9.31 A terrain sensitivity rating of universal validity is a chimera not worth persuing *per se* because of the many possible variations already set out in Section 7.1. It will be preferable to build up a body of relevant data by careful and detailed examination of activities and their effects, as they progress. These case-histories could be used, by analogy, for predictive purposes.

9.32 The general rule "the less digging the better" has merit but the conflict between this concept and the supply of adequate fill material must be resolved.

9.33 One of the more important elements in minimizing the harmful effects of disturbance is a programme for educating all involved personnel in the "why" and "how" of restrictions on their freedom of action. Such a programme and the instructors must be sympathetic both to the needs for environmental stability and to the background and habits of operators of earth-moving equipment.

10 FURTHER STUDIES.

10.1 Revegetation and reclamation.

10.11 With reference not only to pipelines but also to highway construction and other kinds of development, we do not yet know how best to re-establish a vegetation cover on disturbed sites so as to restore the negative thermal regime. Some work is in train - more is needed.

10.12 Where winter exposure of a frozen layer in unavoidable, an insulating layer is needed during the subsequent thaw season. We need to ascertain what materials best serve this need and, at the same time, provide a suitable seedbed for rapid re-colonization by natural or artificial seeding.

10.13 Where a slippage has occurred we need to be able to restabilize the site quickly. No practical work to develop a suitable technique has yet been attempted.

10.14 Although some work has begun, more is needed to determine the effects of terrestrial oil spills and the best reclamation techniques for use following a spill.

10.2 Effects of fire.

10.21 The effects of fire are known, broadly speaking. Since fire lowers the permafrost table it may be possible to use controlled burning, prior to development, to deepen the active layer and thus to simplify working conditions, if sub-surface ice-bodies are known to be absent.

10.3 Ecological processes.

10.31 Little is yet known about successional development in Arctic and sub-Arctic plant communities. More detailed knowledge is necessary to allow us to distinguish between harmful and non-damaging changes induced by man. This requires continuing, long-term study of ecological processes in the North.

10.4 Monitoring proposal.

10.41 It is proposed that series of replicated plots be established on representative sites at two locations, possibly near Wrigley and Arctic Red River. The plots will be carefully assayed for vegetation, microfaunal and microbial populations and soil characteristics. Controlled oil spill and mechanical disturbance treatments will then be applied. The effects of these disturbances will be monitored regularly. Once sufficient data are amassed, these same plots will be used for revegetation studies. Other revegetation and restorative investigations will be carried on concurrently with the disturbance studies.

10.42 The two stations could become foci for a wide range of other environmental studies. The programme will be a long one and there is no point in incurring the inevitably heavy expenditure of installation unless there is some assurance of funds to bring the work to eventual fruition.

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Figure 3. Seismic line through a "drunken forest" near Fort MacPherson.

Figure 4. Bulldozed seismic line in Arctic tundra near Tuktoyaktuk.

Figure 5. Gully erosion in a seismic line.

Figure 6. Natural slippage on Horn escarpment.

Figure 7. Extensive surface disturbance and gully erosion following spring traffic, Dahadinni River.

Figure 8. Surface erosion and incipient gullying in a seismic line on a steepening bank, Redstone River.

Figure 9. A stretch of the Canol Road near Norman Wells.

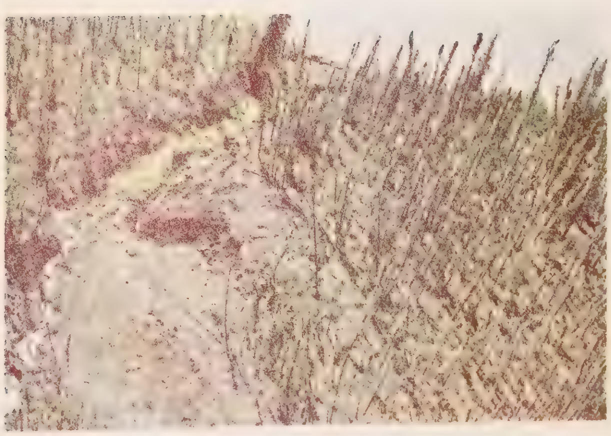

Figure 10. Erosion after the cutting of a seismic line through a water course, near Fort Norman.

Figure 11. Erosion in a seismic line on interbedded sand and silt, northwest of Fort Norman.

Figure 12. Detail of soil profile at Site 11.

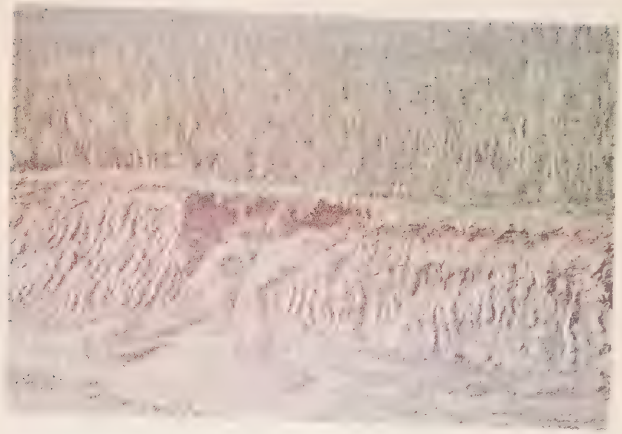

Figure 13. Flow-slide on the Dempster Highway, near Arctic Red River caused by cutting in ice-rich soil.

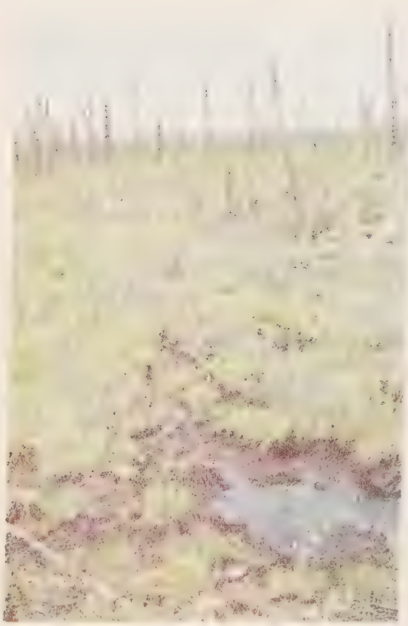

Figure 14. Slight damage and thermal erosion in a cryic gleysol, Fort McPherson.

Figure 15. Deeply excavated seismic line on the Peel Plateau.

Figure 16. Barely visible shallow seismic line.

Figure 17. Downslope continuation of the same seismic line.

Figure 18. Erosion in a stream bed after summer travel, Arctic Red River.

Figure 19. Gully erosion in the Inuvik burn area.

Figure 20. Slight settlement in a shallow seismic line near Eskimo Lakes.

Figure 21. Mackenzie Highway construction near Inuvik breached by unprotected runnel crossings.

APPENDIX I.

Tables 1 to 8. Summaries of site descriptions.

Note: The following symbols have been used in Column 7 to identify the major tree species.

Pinus divaricata	Pj
Larix laricina	Ll
Picea glauca	Sw
P. mariana	Sb
Picea sp. of *P. lutzii*	Picea
Populus balsamifera	Pb
P. tremuloides	Pt
Betula papyrifera	Bp

Other abreviations used in Tables 1 to 8 are:

F.M.R.I. - Vegetation types as defined and mapped by the Forest Management Research Institute, Department of Environment, Ottawa, K1A OW2.

G.S.C. - Landscape units as defined by the Geological Survey of Canada, Calgary.

C.B.C. - Landscape units as defined by C.B. Crampton, Canadian Forestry Service, Edmonton.

N.A. - Not applicable

n.r. - not recorded.

See Pages 7 and 8 of text for further explanation of these site description tables.

TABLE 1

AREA Fort Simpson

No.	Site	Location	F.M.R.I. Type	Landscape Unit: GSC	Landscape Unit: CBC	Natural Community: Trees and Shrubs (dbh in cm / ht. in m / age in yrs.)	Natural Community: Ground Cover	Natural Community: Soil Type and Texture	Natural Community: Depth of organic Layer cm	Natural Community: Depth to Frozen Layer cm	Disturbance: Kind	Disturbance: Season	Disturbance: Elapsed Time Yrs.	Disturbed Community: Ground Cover	Disturbed Community: Depth to organic Layer cm	Disturbed Community: Depth to Frozen Layer cm	Slope	Remarks	Sampling Date
	2	3	1		6	7				11	12	13	14	15	16	17	18	19	
1	Willow Lake Well L59	62°09'N 121°57'W	G	N.A.	51-3	Sb open stand 7.5 9 100	Sphagnum 100% mounded	humic gleysol	30 (Charcoal at 25 cm)	20	Well Site	March '70	2 1/4	Water 25% litter & trash 75%	15	29	Level	no apparent damage.	June '72
2	Willow Lake Well L59	62°09'N 121°57'W	F	N.A	51-3	Sb 1300/ha 20 17 150	Water 60% [illegible] and other spp. 40%	[illegible] gleysol	[illegible]	66	Well Site	March '70	2 1/4	litter & trash 100%	14	33	Level	moving water on surface	June '72
3	Willow Lake Well L59	62°09'N 121°57'W	D	N.A	51-3	Pt, Sw 4500, 800/ha 20 15 55	[illegible] 60% [illegible] spp. 40%	degraded brunisol	5.5	to wet to measure	Well Site	March '70	2 1/4	bare ground 90% [illegible], Salix, etc. 10%	3.5	60	Level	no apparent damage	June '72
4	Willow Lake Well L59	62°09'N 121°57'W	F	N.A.	51-3	Sw, Ll 8300, 4100/ha 10 7.5 50 Ledum, Betula, Salix spp. understorey - 50% canopy	litter 25% Cladina spp. 15% Carex sp. 15% Other spp. 45%	mounded, degraded brunisol	30	25	Well Site	March '70	2 1/4	bare ground 100%	Nil	41	Level	no apparent damage	June '72
5	I.O.E. Trail River, P3	62°03' 121°03'	F	N.A	51-3	Sb, Pj very open stand 10 4 45-50	A/ Sphagnum 40% Water 20% Other spp 40% B/ Mosses 30% [illegible] spp & [illegible] sp & [illegible] 70%	A/ humic organic B/ humic organic	35 >20	32 17	Winter road	Winter '72	<1/2	bare ground 90% Carex sp. 5% Salix sp & [illegible] & Sphagnum spp 5%	Nil	7	Level	A/no apparent damage B/west of road	June '72
6	I.O.E. Trail River, P3	62°03' 121°03'	G	N.A	51-3	Sb, with Pj, Ll very open 10 5 45-50	litter etc. 65% [illegible] spp. 35%	humic organic	[illegible]	2	Well Site	Winter '72	<1/2	bare ground 100%	Nil	23	Level	no apparent damage	June '72
7	0.5 km North From #6	62°03' 121°03'	D	N.A	51-2	A, Pj, Sw 3500/ha 20 14 100 P/Sw, I 7700/ha	[illegible] 70%, Arctostaphylos uva-ursi, etc. 30% litter 45% [illegible] spp. 55%	degraded dystric brunisol	3	32	Winter road	Winter '72	<1/2	bare ground 94% pine litter 5% [illegible] 1%	0	60	[illegible]	undulating, well-drained on mounds	June '72
8	0.1 km east of #6	62°03' 121°03'	D/F	N.A.	51-3	S, Pj Irregular, open 12 7 ?	Sphagnum 50% [illegible] 43% other spp. 7% hummocky	humic organic	>18	18	Fire	July '71	1	on hummocks - L.palustre & Betula 35%, Sphagnum 10%, burned duff 55% In hollows - Sphagnum 10-70%	variable	49	Level	Fire burned with varying intensity, nor surviving trees in more severly burned patches.	June '72
9		62°00' 121°46'	D	N.A.	53-3	Pj 8300/ha 10 8 50	litter 85% grass & other spp. 15%	degraded dystric brunisol	2-3	[illegible]	Seismic line	March '70	2 1/4	litter 80% grass 20%	1	>75	Level	other spp. - [illegible], Linnea [illegible], [illegible] splendens, Cladina spp.	June '72
10		62°00' 121°46'	G	N.A	53-3	Sb very open 7.5 3 45	Cladina spp. 50% L.palustre 36% other spp. 14% hummocky	humic organic	>27	27	Seismic line	March '70	2 1/4	mosses 100%	>24	34	Level	Centre of line depressed 4cm other spp. includes Vaccinium vitis-idaea, V. uliginosum, [illegible]	June'72
11		62°00' 121°46'	H	N.A.	53-3	Salix 3 26 Sb 2.5 3 26	Wet hummocks 60% water 40%	? humic organic	30	[illegible]	Seismic line	March '70	2 1/4	Water 100% with Potentilla sp., [illegible] spp. Salix sp.	10-30	40	Level	Centre of line depressed 20 cm Sphagnum, other mosses forbs & shrubs on hummocks	June '72
12	Willow Lake Well, L59	62°09' 121°57'	I	N.A.	51-3	Sb, Ll, Jp very open 7.5 4 B.glandulosa <1 80% cover	L.palustre, [illegible] splendens etc. 50% Sphagnum 50% hummocky	humic organic	44	44	well site	March '67	5 1/4	bare ground 95% Salix, Carex, Ericaceae 5%	[illegible]	35	Level	no apparent damage	June '72
13	Horn Plateau south scarp	61°55' 120°10'	D	tMp well drained	26-6	Sw 2000/ha 25 20 200 Pb 600/ha 20 20 150 Bp 500/ha 20 20 150	litter 50% H.splendens 40% other spp. 10%	orthic dystric brunisol	12	50	Seismic line	March '70	2 1/4	litter 90% bare ground 10% shrub canopy 15%	>7	90	30%	line surface lowered by 0.7 m incised a further 0.3 m, shale parent material	June '72
14	Mackenzie/ Liard confluence	61°50' 121°16'	A,B	si,sAp Impf. drained	53-2												3%	Profile across small island.	June '72
15	Horn Plateau south scarp	61°57' 119°59'	C	tMp/pO Impf. drained	31-6	Sw, irregular 1200/ha 30 14 150	[illegible] 50% litter 40% other spp. 10%	orthic dystric brunisol	20	>90	Natural slippage	Summer(?)	150(?)	100% litter with A.uva-ursi, H.splendens, V. vitis-idaea 45% bare ground, 20% litter, 35% Pyrola, Linnea borealis, [illegible] sp. Salix spp. 50% bare ground 50% litter, some A.uva-ursi, Pyrola sp. Epilobium angustifolium, [illegible] 95% bare ground, Salix sp. P.balsamifera, Equisetum [illegible]	1-3 Nil Nil Nil		plateau 2% scarp 25%	Mature Sw, 4th stage of recovery. Sw and Pb <4 m, 70 yrs. 3rd stage of recovery Sw, Pb, Bp, Salix <3 m, 30 yrs. 2nd stage of recovery. 1st stage of recovery	June '72
16	Horn Plateau summit	61°58' 120°00'	-	pU Impf drained	31-10	Nil	lichens, esp. [illegible] 100% Some [illegible]	cryic humic organic	15	15	none			N.A.			1%	Examination of a lichen community on polygonally patterned ground	June '72
17	Horn Plateau near Mustard Lake	61°58' 120°12'	F	pU Impf. drained	31-12	Sb 2900/ha 18 10 150	Lichens 50% [illegible] 20% other spp esp. [illegible] 30%	cryic organic	[illegible]	[illegible]	Seismic line	Spring '69	3 1/4	95% trash and litter 5% lichens	12	19	2%	Centre line depressed 25-30 cm	June '72
18	Martin River near mouth	61°52' 121°41'	D	si,sLp Impf. drained	53-[illegible]	Sw 10.5 19.5 75 Pb 12.5 12 P. 12.5 10 12,700/ha	[illegible] 55% litter with sparse forbs and moss 45%	gleysol	12	35	Seismic line followed by thermal erosion	March '70	2 1/4	80% bare ground 20% mosses	8-10	>90	5%	5% slope bulldozed to reduce slope, gully now 2 m deep.	June '72
19	Martin hills east scarp	61°48' 121°49'	H	tMp Impf. drained	51-2	[illegible] 100% canopy to 2 m	litter 20% bare ground 80%	orthic dystric brunisol	5-12	[illegible]	Seismic line	June '71	1	bare ground 50% grass 25% litter 25%	3-9	60	17%	Surface rills where slope >5%	June '72
20	Martin River		A,B,C		53-2												1%	transect across an alluvial spur, Martin River	June '72
21	Goose Lake	61°17' 121°14'	I	pO-fO Poorly drained	61-3	Sb very open 8 5 120	Sphagnum 80% with Carex spp. [illegible] Andromeda polifolia	Sphagnic organic		90	Seismic line	Winter '72	1/2	Sphagnum 50% open water 50%		>90	Level	very poorly drained	June '72
22	S.E. from Fort Simpson	61°34' 121 18'	G	fO,pO Poorly drained	53-8	Pj 7.5 5 25 Sb 10 5 25 [illegible]	litter 60% lichens & moss 35% Sphagnum 5%	Sphagnic organic	>35	35	Winter road & CNT line	Winter '72	1/2	organic matter 90% residual mosses 5% residual Sphagnum 5%	>25	35	Level	very poorly drained, thermokarst. Charcoal obvious at 4 cm depth.	June '72
23	adjoining #22	61°34' 121°18'	I	fO/pO Impf. drained	53-8	[illegible] sp 6% canopy	litter 50% moss 30% grass 20%	humic organic	25-30	20	Winter road & CNT line	Winter '72	1/2	litter with grass tufts 80% moss 20%	20	33	Level	heavily browsed	June '72
24	North of Sibbeston Lake	61°56' 122°[illegible]	F	N.A.	51-1	[illegible] 7.5 6 100	[illegible] with [illegible] and [illegible] 47% moss 40% litter & lichen 13%	cryic rego-gleysol	20-25	25	Seismic camp	May '70	2	incorporated organic matter with Carex spp. and tree seedlings 100%	20-25	>90	Level	no obvious damage	June '72

TABLE 2.

AREA: Wrigley

No.	Site	Location	F.M.R.I. Type	LANDSCAPE UNIT: GSC	LANDSCAPE UNIT: CPC	NATURAL COMMUNITY: Trees and Shrubs (dbh in cm, ht. in m, age in yrs.)	NATURAL COMMUNITY: Ground Cover	NATURAL COMMUNITY: Soil Type and Texture	NATURAL COMMUNITY: Depth of organic Layer cm	NATURAL COMMUNITY: Depth to Frozen Layer cm	DISTURBANCE: Kind	DISTURBANCE: Season	DISTURBANCE: Elapsed Time Yrs	DISTURBED COMMUNITY: Ground Cover	DISTURBED COMMUNITY: Depth of Organic Layer cm	DISTURBED COMMUNITY: Depth to Frozen Layer cm	Slope	Remarks	Sampling Date
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
25	McConnell Lake	62°49' 122°54'	F	tMp¹ poorly drained	31-12D	Sb 12 8 5400/ha 200	mosses (esp. [illegible] 55% [illegible] [illegible] 40%) lichens 5%	humic organic	≃ 50	30	access road to well	Feb. '72	1/2	bare ground 99%	6	43	3%	depression = depth of bulldozing	June '72
26	McConnell Well	62°48' 122°52'	E	R-tMv/R well drained	31-1	Sb 10 6 6700/ha Bp 9 6	lichens 50% H.splendens & [illegible] [illegible] 45% grass 5%	orthic eutric brunisol clay pH 6.3	7	15	well site	Feb '72	1/2	bare ground 100%	[illegible]	too rocky to probe below 40cm 7.0°C@40cm	5%		June '72
27	McConnell Well access	62°49' 122°52'	E	R-tMv/R well drained	31-2	Sb 15 10 2300/ha 175 Bp 1. 8	[illegible] [illegible] 65% [illegible] [illegible] 10% lichens 8% litter 7%	rego-gleysol clay pH 7.4	25	25	access road to well	Feb '72	1/2	bare ground 100%	3	too rocky to probe below 60cm 5.0°C@60cm	7%	7.15 cm rills cut into road	June '72
28	near Highland Lake	62°46' 122°39'	D	tMps well drained	31-2	Pj 18 16 2000/ha 80 Bp 15 16 600/ha 80	litter 66% H.splendens 20% lichen 4% with [illegible]	orthic eutric brunisol clay pH 7.3	11	20	Nil	n.r.	n.r.	Nil	n.r.	n.r.	2%	comparison with adjacent stagnant stand #29	June '72
29	adjoining #28		F	tMps Impf. drained	31-9	Sb 7.5 4 3700/ha 85	mosses 41% [illegible] 25% H.splendens 22% litter 9%	rego-gleysol	21	20	Nil	n.r.	n.r.	Nil	n.r.	n.r	2%	comparison with adjacent healthy stand #28	June '72
30	near Highland Lake		F	tMp¹ Impf. drained	31-11	Sb 10 4 4800 110	[illegible] 36% H.splendens lichens 25% mosses 19% lichens 17% litter 3%	rego-gleysol	3.	32	seismic line	Feb. '72	1/2	mosses 70% litter & trash 21% Carex 8% bare ground 1%	30	32	2%	no apparent degradation	June '72
31	Willow Lake River	62°41'30" 123°05'	D	s,siLp well drained	51-3	[illegible] 20 14 5400/ha 95 Bp 10 12 600/ha 95	H.splendens with lichens 54% litter 25% forbs & grass 11%	orthic eutric brunisol	14	38 frozen rootstock at 15)	Winter road	Winter '72	1/2	sparse grass, forbs and annual herbs	3	40	[illegible]	gully 85 cm deep at edge of river bank; 50 cm deep at 20 m back from edge	June '72
32	Willow Lake River	62°42' 123°05'	B	s,siLp Impf. drained	51-2	Pb, Pt with dense *Salix*, *Alnus incana* understorey	bare ground 20% litter & debris45% mosses 10% forbs 25%	orthic regosol	8	12	Winter road	Winter '72	1/2	n.r.	1-2	18	Level	possible river crossing site	June '72
33	Willow Lake River	62°42' 123°05'	C	g,siAt Impf. drained	51-3	Sb 12 15 170 Sw 13 17 170 Ll 13 17 170 2200/ha	n.r	orthic regosol	6	24	Winter road	Winter '72	1/2	bare ground with incorporated trash & humus94% *Equisetum scirpoides* & herbs 6%	3	15	Level	no apparent degradation	June '72
34	Highland Lake	62°45'30" 122°21'	F	tMp¹ Impf. drained	31-11	Sb 15 10 7400/ha 200 Bp 12.5 11 100	[illegible] [illegible] 55% lichens 34% litter 11%	rego-gleysol	20	20	Well site	Spring '71	1	bare ground with incorporated trash 100%	10	75	Level	no apparent degradation	June '72
35	Highland Lake	62°45'30" 122°21'	F	tMp¹ Impf. drained	31-11	Sb 7.5 8 5600/ha 215	lichens 70% [illegible] [illegible] 2% [illegible] 7%	rego-gleysol	25	20	Well Site	Spring '71	1	residual *H.splendens* 52% bare ground & trash 40% lichens 8%	5 12	31	Level	no apparent degradation	June '72
36	n.w. from Highland Lake	62°51'30" 122°26'	F	tMp¹ Impf. drained	31-12	Sb 10 7 5250/ha 200 Ll 5 6	[illegible] 50% H.splendens & [illegible] 30% litter 16% open water 4%	rego-gleysol	25	20	Seismic line	Spring '71	1	*Carex* tufts 60% litter & trash 40%	10	40	5%	slight gullying of line	June '72
37	adjoining #36	62°51'30" 122°26'	F	tMp¹ Impf. drained	31-12	Sb 10 8 7500/ha 200 Ll 5 7	H.splendens with [illegible] 90% *Sphagnum* 5% litter 5%	rego-gleysol silty-clay loam pH 5.2	20	15	Seismic line	Spring '71	1	bare ground & trash 60% sparse *Carex* & *Equisetum* 40%	0-10 mostly incorporated	40	5%	gully being formed by collected water channels approx. 1.5 m deep	June '72
38	Iverson well site	62°29' 124°28'	H	N.A	36-13	Sb 5 4 400/ha 80 *Betula* [illegible] & *Alnus incana* 80% canopy	*Pleurozium schreberi* 100% hummocks with *H splendens*, lichens & ericas	cryic dystric brunisol loam pH 5.0	10	35-50 varying with surface topography	Well site	July '65	7.0	bare ground 44% trash & litter 29% [illegible] 27%	0-4	40	4%	no apparent degradation	June '72
39	Near #38	62°29' 124°28'	D	N.A.	36-13	Sw(?) 19 4 1400/ha 80	*Pleurozium schreberi* 40% *Sphagnum* 23% *H splendens* 17% litter & lichen20%	cryic dystric brunisol	13	35	Winter roadway	Jan(?) '65	7.0	bare ground & litter 90% mosses & lichens 10%	5	55	2%	shallow soil over shale bedrock	June '72
40	Southern Mackenzie Plain	63°10' 124°00'	D	N A	31-11	*Brulé* *Pices* 3 3200/ha 12 Pj 4 12 Bp 4 12	Continuous canopy *Carex*, grasses & ericas Ground cover 15%	orthic humic gleysol clay pH 5.9	20	30	Seismic line	Summer '62	10	bare ground 99%	15	60	3%	erosion gully 50 cm deep	June '72
41	near Blackwater River	63°50' 123°57'	E	N.A.	31-11	Sb 10 8 14400/ha 100 scattered Pj, Pb, Bp	*H splendens* & ericas 90% lichens 10%	orthic eutric brunisol clay, pH 7.5	15	20	Winter road	Winter '72	1/2	litter & trash 100%	7	55	2-3%	no apparent degradation	June '72
42	40 miles N. of Wrigley	63°45' 123°58'	D	N A.	31-5	Sw 12.5 20 8400/ha 120 Bp 7.5 10 60	*H splendens* 100% with ericas	orthic eutric brunisol clay, pH 6.8	14	20	Winter road	Winter '72	1/2	bare ground 100%	10	60	13%	erosion gully 1 m deep	June '72
43	23 Miles N. of Wrigley	63°32' 123°43'	D	N.A.	31-2	Sw 28 24 2300/ha 200	*H.splendens* 60% *Funaria hygrometrica* 40%	orthic eutric brunisol silty-clay loam pH 7.5	18-21	17-23	post-fire slippage	?	?	bare ground 100% with some litter	15	110 at edge of slippage	60%	a natural phenomenon clay in exposed bank	June '72
44	Ochre River	63°28' 123°37'	G	N.A.	53-3	Sb 10 5 5100/ha 100 many Ll seedlings	*Sphagnum* 37% lichens 28% *H.splendens* & ericas 25% mixed spp. 10%	fibric organic	20	22	Fire	Summer	?	bare ground 50% charred organic matter32% charred mosses 16% *H.splendens* 2%	7	40	2%	shrubs heavily browsed	June '72
45	Roche qui trempe a l'eau	63°24' 123°38'	D	N.A.	53-8	Pj 7.5 8 4300/ha 50 Sb 5.0 6 7400/ha 50	*H.splendens* & ericas 64% mosses 20% litter 16%	orthic eutric brunisol	15 20	30	Well site	Summer '62	10	bare ground 99% mixed forbs 1%	5	65	Level	no apparent degradation	June '72
46	Near #45	63°79' 123°36'	D	N.A.	53-8	Bp 12.5 10 40 3600/ha Sb 10 7 40 *Amelanchier* understorey	litter 95% forbs & *H.splendens* 5%	orthic eutric brunisol	10	60	Winter road	Winter '72	1/2	bare ground 95% mixed forbs 5%	3	>90	2%	no apparent degradation	June '72
47	East of Clover Leaf Lake	63°57'30" 124°36'	G	N.A.	31-9	Sb 7.4 6 2100/ha 165 Ll 3.0 6 1100/ha	*Sphagnum* hummocks 60% lichens 40%	humic organic	>33	30	Access road	late spring '71		bare ground 80% *Eriophorum* & *Carex* 10% *Sphagnum* 5% Open water 5%	15-20	25	3%	width of disturbed zone 280 m. Traffic on thawing ground	June '72
48	Adjoining #47	63°57' 124°36'	I	N.A.	31-9	20% canopy of [illegible] & *Alnus incana*	*Carex* tussocks 40% *B.glandulosa* 10% *Salix* 10% open water 20%	wet organic	>50	50	Access road	late spring '71	1 1/4	*Carex* tussocks 35% shrubs 20% open water 45%	30-40	35	Level	of #47. Still frozen at time of traffic no apparent degradation	June '72
49	5 km west of #47	63°57' 124°38'	F	N.A.	31-9	Sb 7.5 7 10300/ha 100 Ll 12.5 9 600/ha	*Sphagnum* humm. 60% *H.splendens* 30% liverwort 5% open water 5%	orthic rego-gley gleysol clay pH 7.5	28	28 with ice	Access road	late spring '71	1 1/4	bare ground 85% *Carex* 10% crushed shrubs 5%	16	>90	5%	gully 1.5 m deep, water-course intercepted	June '72
50	Redstone River	64°14' 124°34'	D	N.A.	43-2	Sw 2 20 4700/ha 80	*H.splendens* 63% litter 37%	gleyed eutric brunisol loam, pH 7.6	13	28 with ice	Seismic line	April '70	2 1/4	n r	14	75	3-5% above bank, 35% on bank	severe gullying at brow of slope	June '72
51	Redstone River	64°12' 124°34'	H	N.A.	43-?	*Brulé* 70% (± 10) canopy of *Betula glandulosa* *Salix* sp.	lichens 43% ericaceous forb30% *Peltigera apthosa* 27%	lithic regosol clay loam pH 4.4	8	40	Seismic line	April '70	2 1/4	litter or bare ground with *Carex* tufts 57% ericaceous forbs 30% lichens 13%	6	60	7%	no apparent degradation	June '72
No number	24 km south of Wrigley	63°01' 123°14'	L	N.A.	51-2			lithic regosol						bare ground 60% *Arctostaphylos uva-ursi* 30%, *Juniperus* spp. 10%	0	not frozen	65%	restabilised steep bank of creek near Mackenzie R. east bank; 70% slope not eroding	June '72

TABLE 3.

AREA: Fort Norman

No.	Site	Location	F.M.R.I. Type	Landscape Unit GSC	Landscape Unit CSC	Natural Community: Trees and Shrubs (dbh in cm, ht. in m, age in yrs.)	Natural Community: Ground Cover	Natural Community: Soil Type and Texture	Natural Community: Depth of Organic Layer cm	Natural Community: Depth to Frozen Layer	Disturbance: Kind	Disturbance: Season	Disturbance: Elapsed Time Yrs	Disturbed Community: Ground Cover	Disturbed Community: Depth of Organic Layer cm	Disturbed Community: Depth to Frozen Layer cm	Slope	Remarks	Sampling Date
1	2	3	4	5	6	7	8	9	11		12	13	14	15	16	17	18	19	20
52	Slater River	64°56' 126°06'	D		44-4	Bp 1000/ha 24 14 100 Ll 20 16 75 [illegible] *incana* understorey	litter 85% [illegible] 14% [illegible] 1%	cryic orthic gleysol	10-15	[illegible]	Well site	April '66	6 1/4	incorporated humus 96% forbes and *Carex* 4%	10	95	8%	Many small gullies <1 m deep between well site and river bank	June '72
53	Police Island Creek	64°32' 125°07'	F		44-8	Sb 3500/ha 10 8 150 Ll 4300/ha 5 8 many dead trees	[illegible] 50% mosses, lichens & ericas 40% *[illegible] splendens* 10%	cryic orthic gleysol silt loam pH 6.9	17	[illegible]	Winter road	Winter '72	1/2	litter & trash with *Carex* & *Polytrichum* 35% mixed forbs 65%	17	not frozen at 100 cm in centre 40 where humus remains	12 1/2%	Severe gullying (2 m) following recent bulldozing to reduce slope angle	June '72
54	Nota Creek	65°05' 126°05'	F		41-4	Sb 3900/ha 7.5 5 ?200 Ll 7.5 5 2100/ha	[illegible] 45% lichens 40% Moss & litter 15%	cryic orthic gleysol silty-clay loam pH 7.7	20	[illegible]	Seismic line	Winter '72	1/2	*[illegible]* 37% *Aula[illegible]* sp 36% lichens 20% other spp. 7%	0-5	30	Level	shallow (30 cm) ruts	June '72
55	Bear Rock	65°02' 122°44'	F		31-4	Sb 1200/ha 7.5 4 70 fire origin Ll 2.5 400/ha	*[illegible] nitens* 70% litter or bare 17% other spp. 13%	cryic orthic gleysol loamy sand pH 7.5	19	[illegible] with segregated ice	Seismic line	Winter '72	1/2	bare ground with *Carex* 64% *Carex* and mosses 36%	0-5	30	3%	very slight depression	June '72
56	Bear Rock	65°02' 122°44'	E		31-2	Sw 20 17 75	litter with ericaceous forbs 40% *Carex* 15% mosses inc. *[illegible] splendens* 45%	orthic dystric brunisol loam pH 6.9	20	20	Seismic line	Winter '72	1/2	bare ground & litter 25% mosses 20% *V[illegible].vitis-idaea* 20% trash & rubble 10% other spp. 25%	0-2	60-8[illegible]	8%	no apparent degradation	June '72
57	Mackay Well	64°50' 125°30'	C		41-4	Sb 1600/ha 5.0 4 20 Ll 100/ha fire origin 12.5 6 20	mosses 55% litter & bare ground 25% lichens 20%	cryic gleysol silty-clay loam pH 6.5	5	50	Well site	April '71	1 1/4	Bare ground 47% mosses 14% Rubble 10% mixed spp. 29%	3-5	75	Level	no apparent degradation	July '72
58	Mackay Well	64°50' 125°30'	F		41-4	Sb 700/ha 50 3 70 fire origin	lichens 55% *Sphagnum* 35% *Ledum palustre* 10% hummocky	orthic humic gleysol	20-25	20-25	Well Site	April '71	1 1/4	exposed humus 35% lichens 25% rubble 15% residual *Sphagnum* 15% bare ground 10%	15	30	Level	lower lying end much less well-drained than #57	July '72
59	Little Bear River	64°51' 125°56'	D		44-2	Bp 2600/ha 15.0 15 60 Sb 1500/ha 7.5 8	litter 75% *[illegible]* and other mosses 25%	orthic dystric brunisol sandy-clay loam pH 4.8	1	45	Seismic line	April '71	1 1/4	*Polytrichum* sp. 50% grass sod 22% litter 18% mosses 10%	0-10	[illegible] 40 cm, [illegible] to probe deeper	3% above bank 15% on bank	Seismic line halted at edge of bank, gullying developing in bank where slope angle increases sharply.	July '72
60	Dodo Canyon	64°53' 127°14'30"	n.a.		26-13	None	None	artificial lithic regosol	0	n.r.	Canol road	1942	30	bare ground 100%	0	n.r.	1%	*[illegible]* spp. *Salix* sp. *[illegible]ylos rubra*, *[illegible]la fruticosa*, *Pyrola [illegible]* occur sporadically.	July '72
61	West of Fort Norman	64°54' 125°40'	D		43-4	Sw 4200/ha 12.5 16 160 Bp 5.0 12 600/ha	*H.splendens* 70% litter 27% mosses & lichens 3%	cryic eutric brunisol clay pH 5.7	7-10	25	Seismic line	March '71	1 1/4	bare ground 55% rubble 17%, *H.splendens* 18%, litter & sparse grass 18%	0	90	16%	severe gullying	July '72
62	Fort Norman airstrip	64°54' 125°34'	E		45-2	Sb 6500/ha 12.5 10 60 Bp 12.5 10 700/ha many dead Bp	litter 55% *H.splendens* 33% other spp. 12%	orthic eutric brunisol sandy loam/loam pH 7.3	7-10	30 ice lens at 24 cm	Fire	?71	?1	charred litter and humus 99% *Marchantia polymorpha* 1%	5	40-75	1%	frost table very irregular in *brulé*	July '72
63	Canol Road Heart Lake	65°10' 127°13'	D		31-2	Sb 10 5.5 27 800/ha Bp 10 8 27 400/ha Ll, Pb, Pt also present, *Salix* & *Alnus* understorey	litter 50% *H.splendens* 30% grass 20%	orthic dystric brunisol clay loam pH 4.9	12	29	road constr	1942	30	litter 90% litter with grass & *Dryas* sp. 10%	6	40	7%	no deterioration, dry site	July '72
64	Canol Road Heart Lake	65°10' 127°13'	E		31-6	Sb 15 10 160 3100/ha Bp 7.5 7 25 1000/ha *Salix* & *Alnus* understorey	*H.splendens* 60% litter with lichen and *Sphagnum* 40%	cryic lithic regosol silty loam pH 4.1	10-15	30	road constr.	1942	30	bare ground 40% litter 30% *H.splendens* 15% grass, *E.arvense* and mosses 15%	0	?	6%	no deterioration intermediate site	July '72
65	Bear Rock Mackenzie River bank	64°59' 125°38'	F		41-4	Sb 2800/ha 12.5 10 ?120	*H.splendens* with *V[illegible]* *Arctostaphylos rubra* 95% lichens 5% mounded	cryic regosol clay loam pH 6.9	10	20-30 varying inversely with surface mounds	Winter road	1971	1/2	bare ground, sparse *Carex*, *E. arvense* & tree seedlings 40% bare ground 25% *H.splendens* 15% other spp. 20%	0-10	80	15%	severe gullying, to 3.5 m, 2 water courses intersected.	July '72
66	near Norman Wells	65°15' 124°35'	I		43-4	Ll sparse 48 yrs [illegible] *Betula glandulosa*, [illegible]	open water 60% grass & sedge 30% forbs & shrubs 10%	humic organic wet	>100	none	Seismic line re-used	May '72	1/6	open water 60% grass & sedge 40%	>100	-	Level	no degradation.	July '72
67	South of Norman Wells, creek near Mackenzie L.	65°13' 126°22'	D		41-4	Sw 1600/ha 25 20 75	litter 60% *[illegible]* 20% *H.splendens* 10% others incl. [illegible] & [illegible] sp. 10%	cryic eutric brunisol clay loam pH 7.8	17	36	Access road	Winter '71	1/2	bare ground with sparse grass and forbs 100%	10	75	5%	no degradation apparent, some settling of road	July '72
68	near #67	65°12' 126°17'	F		41-4	Sb 3000/ha 12 10 80 Ll 3300/ha 10 6.5 35	litter 60% *[illegible]* 15% *Ledum palustre* 15% other forbs 10%	cryic gleysol silty clay pH 7.7	25	30	Access road	Winter '71	1/2	litter 40% bare ground 40% grass 10% forbs 10%	5	65-90	Level	surface damage	July '72
69	Great Bear River	65°03' 125°15'	*brulé* (F)		45-4	Sb 2.5 2 5700/ha	burned organic matter with *Equisetum arvense* mosses, grasses & *Carex*	rego-gleysol sandy-clay loam pH 5.9	7-10	30	Winter road	Winter '71	1/2	bare ground 85% mosses & *Ledum* 12% *Carex* 2% open water 1%	3-5	75	3%	6 m depression in gully draining former pond	July '72
70	Big Smith river falls	64°33' 122°45'	D		41-4	Picea (?Sw) 3100/ha 12.5 11 150 Bp 2.5 200/ha Ll 2.5 100/ha	*H.splendens* 85% litter 5% other spp. 10%	cryic gleysol sandy loam pH 7.4	25	25	Winter road & CNT line	Winter '71	1/2	rubble 60% humus 20% bare ground 10% mixed forbs & moss 10%	7-10	>90	Level	no degradation noted	July '72
71	Canol Road Heart Lake	65°10' 127°13'	F		31-4	Sb 4050/ha 15 11 165 Bp 700/ha 17.5 15 ? [illegible] understorey	litter 40% *H.splendens* 40% *Sphagnum* 5% mosses & lichens 15% mounded	cryic rego-gleysol silty-clay loam pH 6.2	20 mounds 30 hollows	25-30	road constr.	1942	30	bare ground 70% litter 25% other spp. 5%	gravel berm	-	5%	no degradation	July '72
72	Canol Road	65°12'30" 127°09'	G		31-9	Scattered *Betula glandulosa*	*Cladina* spp. 60% *Dicranum* [illegible] 35% *Sphagnum* 5%	cryic mesisol	20-30	25-30	lightly compr. track	March '69	3 1/4	*Cladina* spp. 40% bare ground 30% *Dicranum* [illegible] 30%	21	21	Level	no degradation, very slight disturbance.	July '72
73	Canol Road near #72	65°12'30" 127°09'	H		31-6	dense [illegible] thicket to 3 m	*H.splendens* & *Vaccinium vitis-idaea* 50% litter 48% *[illegible] nitens* 2%	cryic rego-gleysol clay-loam	14	22	road constr.	1942	30	bare ground 65% litter 30% mixed spp. 5%	gravel berm	-	3%	no degradation	July '72

TABLE 4

AREA: Sans Sault Rapids

No	Site	Location	F.M.R.I Type	Landscape Unit: GSC	Landscape Unit: CBC	Natural Community: Trees and Shrubs (dbh in cm, ht. in m, age in yrs.)	Natural Community: Ground Cover	Natural Community: Soil Type and Texture	Natural Community: Depth of Organic Layer cm	Natural Community: Depth to Frozen Layer cm	Disturbance: Kind	Disturbance: Season	Disturbance: Elapsed Time Yrs	Disturbed Community: Ground Cover	Disturbed Community: Depth of Organic Layer cm	Disturbed Community: Depth to Frozen Layer cm	Slope	Remarks	Sampling Date
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
74	Ramparts River	65°44' 130°01'	G	tMp Poorly drained	*	Sb 2500/ha 10 7.5 ? Ll 250/ha many dead trees	*Sphagnum* 55% *Cladina* spp 40% litter 5% mounded	cryic rego-gleysol silty clay pH 4.2	13-14	25-40	Seismic line	April '70	2 1/4	trash & litter 33% bared humus 30% ericaceous forbs 15% other spp. 22%	10	27	Level	small thermokarst holes forming in seismic line	July '72
75	nr. Ramparts River	65°49' 130°43'	F (immature)	N.A.		Sb 4200/ha 7.5 8 120 Ll 7.5 7 500/ha	lichens esp. *Cladina* 70% *Sphagnum* 20% other spp. 10% hummocky	cryic rego-gleysol	20	35	Fire	?	?	burned humus 45% *Ledum palustre* 40% litter 7% other spp. 8%	0-10	50-80 varying with surface hummocks	10%	apparently severe fire within past 5 years	July '72
								clay pH 7.5			Seismic line	Feb. '69	3 1/2	bare ground 45% bare with mosses 30% bare, grass tufts 25%	0-5	40-60		0.7 m gully in seismic line cut after the fire	
76	N.W. from SANS SAULT RAPIDS	65°48'30" 129°	D	s,siLp mod-well drained	43-2	Sw 700/ha 7.5 10 90 Sb 2800/ha 5.0 9 90 Pb 5.0 10 1400/ha Pt 5.0 8 100/ha Bp 5.0 10 800/ha	*Cladina* spp 35% *Arctostaphylos rubra* 20% bare ground 10% litter 10% other spp. esp. ericaceous forb25%	orthic dystric brunisol	15-20	>70	Seismic line	May '69	3	bare ground with sparse *Salix* & erica spp. 65% trash & rubble 37%	0	>90	Level	no apparent damage	July '72
											Seismic line	May '69	3	bare ground 100%	0	>90	15%	0.75 m gully along seismic line, unstable banks	
77	nr. Mackenzie River west bank	65°47'30" 128°50'	D	siAt Impf. drained	43-4	Sb 2000/ha 2.5 3 30 Bp 1000/ha 2.5 4 ?	mosses 50% litter 20% ericaceous forb20% grass & lichen 10%	cryic gleysol	20	25	Winter road	Winter '72	1/2	*Carex* & open water 40% trash & rubble 30% mosses & ericas 30%	20	45	Level	approx. 30 cm surface settling	July '72
78	Chick Lake	65°46' 127°54'	F	N.A.	31-4	Sb 5100/ha 7.5 6 125 irregularly burned in recent past	*Ledum* & litter 30% *Funaria hygrometrica* 30% litter & burned humus with ericaceous spp.40%	cryic rego-gleysol	25	23 unburned 40 burned	Seismic line	20	40	trash & litter 96% *Ledum palustre* 4%	15	40	2%	35-40 cm surface settling	July '72
79	Mt. Brokenoff	65°39' 127°45'	F	N.A.	36-4	*Picea* 1880/ha 7.5 70 100	mosses inc. *H. splendens T.nitens* 55% *Cladina* spp 25% litter 10% other spp 10% hummocky	cryic regosol	15-20	35-50 varying with hummocks	Winter road & CNT line line	April '72	1/2	trash & litter 30% residual *Sphagnum* 25% residual mosses 25% lichens esp *Cladina* 10% exposed humus 10%	15-20	40	4%	no apparent degradation	July '72
80	Crescent Lake	65°28' 127°27'30"	D	N.A.	43-4	Sw 4000/ha 22.5 23 120 many dead & dying Pb, Pt, Bp	*H.splendens* with other spp 97% litter 3%	orthic dystric brunisol sand pH 4.7	6	>90	Winter road	1972	1/2	litter 30% bare ground 30% trash & debris 15% grass 20% mosses 5%	0	>90	Level	no depression of surface but unexplained slump hole in centre of road	July '72
81	South of Mt. Brokenoff	65°37'30" 127°47'	D	N.A.	43-4	Bp 10 10 43 *Picea* 7.5 7.5 41 Dense *Salix-Alnus* understorey	very variable litter 5-95% *Arcto.uva-ursi*0-50%	cryic rego-gleysol sandy-clay loam pH 7.50	5-10	40	Seismic line	1972	1/2	trash & litter with *Calamagrostis* sp 100%	2	60	Level	no apparent degradation	July '72
82	south of Ft. Good Hope	66°13' 128°32'	G	pO Impf. drained		Sb 1150/ha 10 7 200 many dead trees	*Sphagnum* 60% *Cladina* spp 35% litter 5%	cryic humic	>30	30	Seismic line	April '66	6 1/4	exposed humus 80% residual *Sphagnum* & lichens 20%	40	40	Level	slight depression in centre of line	July '72
83	south of #82	66°05' 128°47'	F	tMv Poorly drained		Sb 5700/ha 7.5 7 57 *Salix* dense understorey up to 2 m tall, recent fire origin	mosses w. *Equisetum scirpoides* 70% *Equisetum arvense* 20% litter 10%	cryic gleysol clay loam pH 7.5	10	70-90	Winter road	1972	1/2	*Carex* & moss 90% *Carex* & *Marchantia* 10%	6	>90	Level	no apparent degradation	July '72
84	Hume River	66°01' 129°14'	D	GLKp mod-well drained		mosaic of Sw,Sl,Bp,Ll communities w.irregular *Salix/Alnus* understorey, prob. fire pattern effec	mosses & litter in varying proportions	orthic eutric brunisol sand, pH 7.8	5-10	75	Seismic line	? possibly May '69	(?) 3	sparse herb cover 66% bare ground 34%	0-5	>90	25%	gully 1.3 deep apparently due to mechanical erosion	July '72
85	N.W. from Gibson Range	66°00'30" 128°31'	F	tMp Impf. drained	33-9	Sb 2.5 1000/ha 50% *Betula glandulosa* canopy recent fire origin	charred humus 85% *Sphagnum* on low hummocks 15%	cryic humic	30	30	Seismic line	? possibly May '67	(?) 5	charred humus 95% mosses 5%	30	30	Level	10-15 cm surface settling	July '72
86	Mackenzie R. at Sans Sault Rapids	65°42' 128°40'	G	si,cLpk Poorly drained	43-4	Sb very dense 2.5 3 45 *Salix* understorey, mounded sur.	*H.splendens* 93% *Cladonia mitis* 4% *Sphagnum* 3%	cryic humic	45	27	Old Camp site	?	no records	30 yr. old Sb *Sphagnum* 80% litter 20%	45	42	Level	no apparent degradation	July '72
87	Ridge near Carcajou R.	65°32' 128°03'	E	tMv Impf. drained	31-6	Sb dense 10 7 70 Ll,Bp & *Alnus* understorey	*H.splendens* 93% *Sphagnum* 7%	cryic gleysol	20	20	Seismic line	April '70	2 1/4	trash & debris 40% water 15% gravel & stones 5% mixed herbs 40%	11	>90	2%	extensive gullying through soil to parent material	July '72
88	Oscar Lake	65°29' 127°14'	G	N.A.	31-9	Sparse Sb,Ll stand with *Salix* 30% canopy to 3 m hummocky surface	*Dicranum* sp 40% *T.nitens* 30% burned humus 10% ericaceous forb20%	cryic gleysol clay pH 7.1	12	25	Access road	May '71	1 1/4	wet bare ground 80% residual *Sphagnum* 20%	13	60	4%	extensive surface damage following spring traffic of #47	July '72
89A	Oscar Creek	65°27' 127°18'	E	N.A.	31-9	Sb 6100/ha 5 4 35	litter 50% *Vacc.vitis-idaea* 20% lichens & moss 20% *Ledum palustre* 10%	cryic gleysol sandy loam pH 7.5	20	70	Seismic line	May '71	1 1/4	cover of residual species 90% bare ground 10%	25	>90	Level	no apparent degradation	July '72
89B	Oscar Creek	65°27' 127°18'	E	N.A.	31-11	Sb 5500/ha 2.5 5 35 Bp 50 2 ?	litter with ericas 70% mosses 30%	cryic gleysol	40	28	Seismic line	May '71	1 1/4	bare ground 55% *Vacc.uliginosum* 20% litter 20% moss 5%	10	>90	12%	no apparent degradation	July '72
90	Mountain R.	65°40' 128°55'	L	si,s g Ap mod-well drained	33-9	Sb 1300/ha 10 8 ? Bp 10 7 900/ha Ll 5 4 400/ha	*Hylocomium splendens* with ericas 100%	cryic dystric brunisol (ice lenses)	20	25	Access road	March '71	1 1/2	*H.splendens* 53% bare ground 40% open water 7%	17	40->90	5%	road crosses drainage channel where gully erosion is severe	July '72

* northern limits of Crampton's study area.

Note * This and other more northerly sites were beyond the range of Crampton's survey.

TABLE 5.

AREA: Fort Good Hope

No.	Site	Location	F.M.R.I Type	LANDSCAPE UNIT: GSC	LANDSCAPE UNIT: LUC	NATURAL COMMUNITY: Trees and Shrubs (dbh in cm, ht in m, age in yrs)	NATURAL COMMUNITY: Ground Cover	NATURAL COMMUNITY: Soil Type and Texture	NATURAL COMMUNITY: Depth of Organic Layer cm	NATURAL COMMUNITY: Depth to Frozen Layer cm	DISTURBANCE: Kind	DISTURBANCE: Season	DISTURBANCE: Elapsed Time Yrs	DISTURBED COMMUNITY: Ground Cover	DISTURBED COMMUNITY: Depth of Organic Layer cm	DISTURBED COMMUNITY: Depth to Frozen Layer cm	[illegible]	[illegible]	[illegible]
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
91	Snafu Lake	66°00'30" 128°30'	F	tMp Impf. drained		Sb recent fire origin Open Sb and Ll stand	burned humus 70% [illegible] [illegible] 10% litter w [illegible] 10%	cryic rego-gleysol	25	45	Airstrip constr.	April '66	6 1/4	burned humus 55% [illegible] 30% [illegible] 10% litter [illegible]	20	80	2%	no apparent degradation	[illegible]
92	near Snafu Lake	66°00'30" 128°29'	F	tMp Impf. drained		Sb 10 6 ?120 5000/ha	Salix spp 67% Sphagnum 30% other spp. 3%	cryic rego-gleysol	25	[illegible]	CNT line	April '66	6 1/4	organic debris 70% rubble [illegible] residual mosses & Sphagnum 10%	20	36	Level	no apparent degradation	[illegible]
93	North of #92	66°00'30" 128°29'	G	tMp Poorly drained		Sb 2.5 3 60 open stand	Cladina spp. 70% Sphagnum 30% hummocky	cryic rego-gleysol	>30 Charcoal at 12 cm	30	Seismic line	April '66	6 1/4	organic debris 60% rubble 40%	48 abundant charcoal	40	Level	30 cm settling [illegible] of line	[illegible]
94	8 km. SE from Ft. Good Hope	66°11' 128°31'	G	fpO Impf. drained		Sb 5 4 100 5000/ha with *Betula glandulosa* understorey	*Cladina* spp. 50% *Carex* spp. 20% *Sphagnum* 15% other spp water 10%	humic organic	>25	[illegible] (5' below water)	Seismic line		?	organic debris 45% rubble 25% *Sphagnum* 30%	>35	40	Level	20 cm settling [illegible] of line	[illegible]
95	Ontadeck Lake	66°18'30" 128°21'	Φ(F)	tMp Impf. drained		Sb very dense fire origin stand 2.5 3 35	litter 35% *Arcto.rubra* 50% lichens 15%	orthic eutric brunisol silty clay loam pH 7.7	5	44	Airstrip constr.	Winter '71	1 1/2	organic debris 70% rubble 25% *Arcto.rubra* 5%	11	90	[illegible]	[illegible]7 cm depression in [illegible] side of runway	[illegible]
96	Hare Indian River	66°18' 128°35'	F	sgup Impf. drained		Sb 10 8.5 130 17000/ha Ll ? 7 700/ha *Salix & B. glandulosa* understorey	litter 40% *E.arvense* 40% mosses 20% with associated *Reros*	cryic rego-gleysol sandy loam pH 7.7	12-20	[illegible]	Access road	Winter '72	1/2	organic debris 40% sedges 35% bare ground with *E.arvense* 25%	15	>90	[illegible]	1[illegible] cm depression in line	[illegible]
97	Loon River	66°30' 128°54'	F	tMp Impf. drained		Picea 12.5 10 ? 10000/ha Bp 2.5 3 ? 100/ha	*H.splendens* 40% litter 30% *T.nitens* 25% *Cladina* spp. 5% hummocky	orthic brunisol sand pH 7.6	8	30-50 varying with moisture & hummocks	C.N.T. line	Winter '72	1/2	litter & rubble 50% bare ground 30% mixed herbs 20%	1	10°C at 30 cm too rocky to probe more deeply	[illegible]	60 cm gully in cleared line	July '72
98	nr. Rory Lake	66°40' 128°15'	F/G	tMpv Poorly drained		Sb 12.5 10 150 4800/ha Ll 10 800/ha *Salix* understorey	mosses 90% *Carex* 5% litter & lichens 5%	cryic-rego-gleysol silty loam pH 7.7	8-20	40	Seismic line	April '66	6 1/4	wet mosses [illegible] rubble [illegible] sedges [illegible]	[illegible]	95	Level	[illegible] line	[illegible]
99	Mackenzie Plain	66°18' 129°06'	E	tMpv Impf. drained		Sb 11 8 226 8000/ha Sw 14.5 11.5 65 Ll 7.5 7 50 apparently a 2-aged stand	litter & forbs 40% *Equisetum arvense* 35% mosses 20% lichens 5%	cryic rego-gleysol sandy clay loam pH 7.[illegible]	12-20	90	Seismic line	May '65	7 1/4	*Carex* spp. 37% *Marchantia polymorpha* 20% bare ground 14% *E. arvense* 13% litter & rubble 13% open water 3%	10	90	Level	37 cm settling in cut line, small fire burned line and adjoining stand beginning in post-cut trash pile.	July '72
100	nr. mouth of Hume River	66°12'30" 129°09'	Φ	siGLp Impf. drained		Bp & Sb very dense stand 6 - 7 years	burned mosses 50% *Marchantia/ Funaria* sp. 45% herbs 5%	cryic rego-gleysol silty clay pH 6.5	7	60	Seismic line	May '65	7 1/4	sedge/moss 40% bare ground w.grass 35% bare ground 15% litter & trash 10%	9	75	[illegible]	line cut before the fire and was not burned	July '72
101	Hume River	66°04' 129°37'	E	si,sLkp Impf. drained		Sw 22.5 18 200 1900/ha Some Sb & Bp with sparse *Alnus* understorey	*H. splendens* 95% mixed moss & forbs 5%	orthic humic gleysol clay pH 6.0	10	40	Fire	?	?	burned moss & *Epilobium* 80% *Marchantia polymorpha* 20%	0-5	10-45	8% above bank 15-20% cm slope	v. irregular ground surface in burned area due to soil creep, ice wedges distorted by movement.	July '72
											slippage & restabiliza-tion	Spring (?)	?	Sparse *Salix* sp (cf interior) bare grnd. 46% litter 25% *Linnea borealis* 20% mosses 9%	0	9°C at 60 cm inpene-trable clay below this depth	10%	surface very hard and dry south aspect [illegible] an unfavourable seedbed.	
102	Yeltea Lake	66°48' 129°40'	F	U Impf. drained		Sb 10 6 (?)120 3000/ha Some Ll present	*Cladina* spp. 75% mosses 25% moderate hummocks	orthic humic gleysol clay pH 7.1	11	50 below lichens >90 below wet hollow	Access road & CNT Line	Winter '72	1/2	rubble & litter 50% sedge & *E.arvense* 35% residual lichens 10% other forbs 5%	10	>90	2%	slight depression apparent in roadway	July '72
103	Tieda River	66°40' 129°15'	F	tMpv Impf. drained		Sb 10 4 (?) 150 3000/ha Trees moribund, with sparse Bp, Ll & *Alnus*	mosses with ericaceous forbs 60% *Cladina alpestris* with forbs 40%	cryic rego-gleysol	20	60	Access road lightly scraped	Winter '72	1/2	bare with litter 40% lichens & mosses 22% ericaceous forbs 18% mosses 15% herbs 5%	15	90	5%	no apparent degradation	July '72
104	Hare Indian River mouth	66°17' 128°39'	G	siApk Poorly drained		Sb 7.5 3 ? 75 4600/ha Some Ll & *Betula glandulosa*	sedges with *Vacc. uliginosum* 80% mosses 10% lichens 10%	orthic humic gleysol	45	50	Access road	Winter & Spring '72	1/4	bare w. sparse *E.arvense* 70% rubble 20% *Arctostaphylos rubra* 10%	0-2	7°C at 75 cm gravelly & impenetr-able below	Level	severely rutted and churned	July '72
105	Yeltea Lake near #102	66°40' 128°15'	G	Al Impf. drained		Sb 7.5 4 ? 100 1900/ha Some Ll, *Salix & Betula glandulosa* stagnant stand	mosses esp. *Tomenthypnum nitens* 60% lichens 30% bare w.*Carex* 10%	cryic rego-gleysol silty clay pH 7.0	10	90	Seismic line	April '65	6 1/4	rubble 40% grass & sedge 40% *E.arvense* 10% bare ground 10%	10	>90	Level	slight depression in cut line very high moisture content in this soil.	July '72

TABLE 6.

AREA: Fort McPherson

No.	Site	Location	F.M.R.I. Type	Landscape Unit: GSC	Landscape Unit: Cbr	Natural Community: Trees and Shrubs (dbh in cm, ht. in m, age in yrs.)	Natural Community: Ground Cover	Natural Community: Soil Type and Texture	Natural Community: Depth of Organic Layer cm	Natural Community: Depth to Frozen Layer cm	Disturbance: Kind	Disturbance: Season	Disturbance: Elapsed Time Yrs	Disturbed Community: Ground Cover	Disturbed Community: Depth of Organic Layer cm	Disturbed Community: Depth to Frozen Layer cm		Remarks	Sampling Date
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
106	Rat River	67°45' 135°22'	E/H	siApk Poorly drained		Sw 5 6 ? 500/ha very open stand over scattered [illegible] clumps	mosses with ericaceous forb 75% lichens with ericaceous forb 15% ericaceous forb 10%	cryic gleysol silty clay loam pH 6.0	18	[illegible]	Seismic line	March '70	2 1/2	organic debris 60% lichens 20% [illegible] & other spp 20%	25	62	[illegible]	slight depression [illegible] which is watered [illegible]	[illegible]
107	North of #106	67°51' 135°27'30"	H	tMv Impf. drained		Betula glandulosa & Salix spp. 80% canopy with sparse Sw, [illegible] & Spirea douglasii & Bp	ericaceous forbs w. Carex & [illegible] spp. 95% Carex tussocks 5%	cryic reg-gleysol clay pH 4.3	23	[illegible]	Seismic line	March '70	2 1/2	bare ground w. [illegible] 40% bare ground w. [illegible] tufts 20% litter & debris 30% open water 10%	12	58	[illegible]	small thermokarst [illegible] forming in cut line	[illegible]
108	near Longstick Creek	67°45' 135°35'	H	tMm Impf. drained		B.glandulosa - 70% canopy with Alnus & Salix clumps polygonally patterned site	lichens 80% Sphagnum 5% Carex tussocks 5% grass 5% other herbs 5%	cryic rego-gleysol loam pH 7.2	20-30	2[illegible]-70	Seismic line	March '70	2 1/2	bare ground 50%	50	30-38	[illegible]	no apparent degradation [illegible] note levelling of [illegible] table	[illegible]
109	near Stony Creek	67°22'30" 135°15'	H	P Poorly drained		sparse Sw & Alnus over polygonally patterned moor	lichens 65% sedge tussocks 35% with ericaceous forbs	cryic rego-gleysol	>30	25-[illegible]	Seismic line	April '67	5 1/2	lichens 70% tussocks, lightly scraped 30%	>30	30	[illegible]	no apparent degradation	[illegible]
110	Richardson foothills	67°22'30" 125°50'	H	Cv Impf. drained		scattered 40 yr old Betula glandulosa with scattered Alnus clumps	moss w. Salix & B.glandulosa 50% moss w. ericaceous forbs & Carex 45% Sphagnum & Carex 5%	orthic dystric brunisol clay pH 4.5	7	62	Seismic line	April '67	5 1/2	litter & debris 50% bare ground w. moss 20% Calamagrostis canadensis 10% other herbs 20%	0-3	7°C at 3[illegible] cm coarse gravelly horizon impenetrable	[illegible]	cut line now a "trench" 75 cm deep.	[illegible]
111	near Stony Creek	67°22'30" 135°32'	H	P Impf. drained		stunted Sb over open Salix Alnus thicket	Cladina spp. 50% Sphagnum 45% litter & mosses 5% hummocks well defined	orthic humic gleysol silty clay pH 4.1	18	30-modal depth 15-50 range	Seismic line	April '67	5 1/2	litter & debris w. Carex & B.glandulosa 75% Carex, Eriophorum & Calamagrostis spp 25%	11	60	[illegible]	cut line depressed [illegible] 65 cm	[illegible]
112a	W. Shiltee Rock	67°14'30" 135°13'	G	tMm Poorly drained		sparse Alnus incana, in wet hollow	Sphagnum w. ericaceous forbs 100%, hummocks	humic organic	8-40	40	Seismic line	April '67	5 1/2	litter & debris 75% residual Sphagnum 25% hummocks	30	42	Level	cut line depressed 60 cm	July '72
112b	W. Shiltee Rock	67°14'30" 135°13'	G	tMm Impf. drained		stunted Sb over Alnus open thicket, in better drained slightly elevated site	Sphagnum 60% sedge tussocks 10% lichens 10% other herbs 19% bare frost boils 1%	cryic regosol clay pH 3.8	5 25	25	Seismic line	April '67	5 1/2	lightly scrapped, similar composition to undisturb. except 10% bare ground	14	75	[illegible]	cut line depressed 65 [illegible]	July '72
113	Dempster Highway	67°13' 135°26'	F	tMm Impf. drained		Sb 2.5 1.5 stunted 50 Ll 2.5 1.5 55-60 over [illegible] clumps & B.glandulosa	Sphagnum 47% lichens w. [illegible] vitis-idaea 30% Ledum palustre 17% other spp. 3% mounded surface	cryic regosol	10	20	Highway constr.	May '70	2 1/4	residual Sphagnum 40% dead plant remains 25% bare ground 20% residual spp. 15%	10	60	2%	1.25 m gully formed at centre of cleared strip	July '72
114	W. Vitrekwa River	67°05' 135°19'	G	tMmv Impf. drained		Sb 7.5 3 ? 4400/ha with Ll, Alnus & B.glandulosa; a stagnant stand	lichens 50% Sphagnum 20% Pleurozium schreberi 30%	cryic rego-gleysol clay pH 3.9	10-17	30-40	Seismic line	May '70	2 1/4	bare w. E.arvense 25% trash & litter 35% residual communities 40%	10	50-70	10%	light scraping has caused no obvious degradation	July '72
											Seismic line	(?) 1967	(?)5 1/2	bare with scattered E. arvense & B.glandulosa 70% debris & litter 30%	1	>90		0.5 m depression of cut line	July '72
115	Satah River	67°05' 134°27'	G	tMmv Poorly drained		Sb 5 3 ? 2100/ha Ll 2.4 3 over B.glandulosa, hummocky with thermokarst ponds	mosses 65% Carex tussocks 12% Carex Andromeda tussocks 18% Sphagnum 5%	humic organic	25-60	22-50	Seismic line	May '70	2 1/4	Carex, Salix & water 25% debris 25% B.glandulosa & water 20% sedge tussocks 20% other spp. 10%	65 (very wet)	60	Level -	only very slight depression observed	July '72
116	near Satah River	67°04' 134°32'	G	P Poorly drained		Sb 5 5 150 1700/ha Ll 2.5 3 100/ha with some Ll and B.glandulosa	Cladina spp. 68% Sphagnum hummocks 32%	humic organic	>20-35	32 in depression 48 in hollow	Seismic line	May '70	2 1/4	trash & litter 37% Sphagnum peat 34% residual lichens 24% residual Sphagnum 5%	55	50	Level	no apparent degradation	July '72
117	W. Shiltee Rock on east bank of Peel River	67°11' 134°40'	L	tMv² mod-well drained		Sb 15 4 180 2800/ha some Ll & Betula glandulosa, Shepherdia canadensis	mosses, esp. H. splendens, T. nitens 85% lichens 15%	cryic eutric brunisol sandy loam pH 7.3	14-28	48 with ice lenses above this depth	access road bull-dozed	May '70	2 1/4	trash & litter 50% bare ground 20% residual lichens 11% other residual spp. 19%	4	70	2[illegible]%	despite the slope and ice content, no degradation was noted	July '72
118a	W. Shiltee Rock on east bank Peel R.	67°20' 134°48'30"	L	siApk Poorly drained		Sw 2.5 4 ? 2000/ha with Bp and Salix/B.glandulosa understorey	litter, ericas 49% Sphagnum humm. 31% mosses, lichens 20%	cryic gleysol clay pH 4.6	18	30	Seismic line	April '71	1 1/4	Sphagnum hummocks 48% litter & ericas 39% other spp. 13%	12	62	Level	25 cm settling of cut line	July '72
118b	adjoining #118a	67°20' 134°48'30"	L	si/sh tMv¹ mod.well drained		Sw 12.5 6 80 2000/ha w. dense Salix/Alnus understorey	litter 62% H.splendens 30% bare ground 8%	cryic dystric brunisol clay, pH 6.4	12	0°C at 40 cm, too rocky below to be probed	Seismic line	April '71	1 1/4	litter & forbs 39% mosses & grass 25% rubble & bare ground 36%	8	60	35%	56 cm depression of cut line no gully erosion seen	July '72
119	Richardson foothills	67°26' 135°42'	H	P Impf. drained		scattered Betula glandulosa moor	Cetraria nivalis 59% mosses 28% Carex spp. 13%	cryic regosol clay pH 4.3	5	40	Seismic line bull-dozed	April '71	1 1/4	Calamagrostis canadensis 25%, bare ground 22% forbs 16% water & Eriophorum 14% residual lichens 13%	0-5	3°C at 75 cm, too rocky to probe below this	3%	cut line incised to 1 m depression	July '72
120a	Richardson foothills	67°26'30" 135°30'30"	L	P Mod-well drained		70% B. glandulosa canopy <1m with some Salix	ericaceous forb 56% mixed forbs 34% litter 10%	cryic gleysol	8	77	Seismic line	April '71	1 1/4	bare ground 75% rock & water 15% residual spp. 10%	0	4°C @ 60cm too rocky to probe below this	24%	gullying down to siltstone bedrock cf 120b	July '72
120b	adjoining #120a	67°26'30" 135°30'30"	H	P Poorly drained		scattered B.glandulosa moor	lichen hummocks 54% Sphagnum 30% Carex tussocks 16%	cryic gleysol	0-15	47	Seismic line	April '71	1 1/4	residual lichens 58% residual Sphagnum 28% residual Carex 14%	0-15	77	1%	no apparent degradation	July '72
121	Peel plateau	67°25' 135°18'	H	tMmk Impf. drained		Sb/Alnus thicket with B.glandulosa	lichen hummocks 60% Sphagnum 20% Carex tussocks 20%	cryic rego-gleysol	20	20-63	Seismic line	April '67	5 1/4	Eriophorum & Salix 37% ericas & grass 36% rubble 10% other spp. 17%	5	75	12%	0.8 m depression of cut line	July '72
122	flat terrace on west bank Peel River	67°25' 134°58'	G/H	siApk Poorly drained		stunted, scattered Sb over dead Salix, Alnus open thicket and B.glandulosa understorey	grass with E. arvense 40% Sphagnum 24% litter w.Carex 19% mosses 17%	cryic rego-gleysol	15	30	Access road abandon then re-used	May '72	1/4	wet mineral soil 54% open water 17% grass, some dead 27% litter 2%	0	70	Level	traffic over re-colonising vegetation has been very destructive. Ruts 22 cm below old restabilized surface.	July '72
123	Richardson foothills, near near Rat R.	67°38'30" 135°26'30"	H	tMmk Impf drained		B.glandulosa hummocky moor	erica/moss hummocks 81% erica/Sphagnum 17% Carex tussocks 2%	cryic regosol clay pH 4.1	12	15-50 varying with micro-topography	road	April '67	5 1/4	litter with Carex 52% trash & debris 44% Sphagnum 4%	0-5	42	10%	66 cm settling in road, thermokarst holes forming possible due to melting of small ice lenses.	July '72
124	Peel Plateau	67°29'30" 135°11'	F	tMv Poorly drained		Sb 5 5 45 2600/ha with B.glandulosa understorey, hummockyy	Sphagnum erica 61% lichen/erica 23% Carex tussocks 10% litter 6%	cryic gleysol clay pH 4.4	12	12-70 varying with micro-topography	Seismic line	April '67	5 1/4	rubble 56% bare ground 22% grass & Carex 12% water 10%	0	>90	Level	line gullied to approx. 2 m depth exposing gravelly 'C' horizon.	July '72
125	S.E. from Ft. McPherson	67°01' 134°00'	G	pO/tMp Impf. drained		Sb 5 8 140 1400/ha Ll, sporadic, B.glandulosa diffuse understorey	lichens & hummocks 49% Sphagnum 19% Ledum & other forbs 32%, edge of thermokarst pond	humic organic	26-40	34-58	Seismic line	April '71	1 1/4	residual lichen 46% Sphagnum 39% rubble 15%	10-15	50	Level	small thermokarst depressions in cut line ≅ 20 cms	July '72
126	near Arctic Red River	67°02'30" 133°25'30"	G	tMv Impf. drained		Sb 10 9 ?220 4700/ha moribund stand with some Ll, Alnus & Salix interior	lichens 30% litter 29% liverwort 22% Carex tussock 10% mosses 9%	cryic rego-gleysol clay pH 5.3	16-22	60	Seismic line	April '71	1 1/4	rubble & mineral soil 76% Carex tufts 9% water 3% litter, residual plants 12%	0-12	>90	13%	gully 1.8 m deep cutting across seismic line & eroding into level ground. Sizable mud outwash "fan" developing at foot of slope.	July '72
127a	Dempster Highway	67°24' 134°27'30"	F	tMm Impf. drained		Sb 5 6 110 6500/ha w. some Sw, Bp, Alnus & Salix spp	Cladina spp. 37% litter 33% mosses 16% Sphagnum & liverwort 14%	cryic rego-gleysol clay pH 5.8	20 charcoal at 20	25-55	road constr.	April '71	1 1/4	mud flow slide developing in face of road cut below undisturbed community.				Flow slides seem to be associated with slight elevations on meso-topographic scale. No other surface features suggested the likelihood of slides forming after disturbance.	July '72
127b	Dempster Highway	67°24' 134°27'30"	F	tMm Impf. drained		Sb 10 7 110 7400/ha	lichen/erica mounds 34% lichen/grass 31% mosses 19% Peltigera & Cladina spp 13% Sphagnum 3%	cryic rego-gleysol silty-loam pH 5.0	22	50	road constr.	April '71	1 1/4	cut bank remaining stable below undisturbed community				See 127a	July '72
128	Dempster Highway	67°23' 134°06'	F	tMp [illegible] drained		Sb 10 7 225 6700/ha sparse Ll, scattered Alnus & Salix understorey	Cladina spp. 55% mosses 32% litter 10% Carex tussocks 3%	cryic rego-gleysol clay loam pH 7.4	0 or 2-12	37-55 varying with micro-topography	road works	Winter '71	1 1/2	bare ground 30% trash & litter 25% Carex, Eriophorum & water 45%	10-15 incorporated organic matter	60-80	Level	wet ruts to 0.5 m formed in access roads	Aug. '72
129	Dempster Highway	67°23'30" 134°23'	[illegible]	tMm Impf. drained		Sb 10 10 150 2300/ha Bp 7.5 3 25 600/ha open Alnus/Salix understorey	Ledum palustre 36% litter 30% mosses 20% other spp. 14%	orthic eutric brunisol sandy loam pH 7.6	9	5-45 varying with micro-topography	borrow pit	Spring '72	1/2	bare ground 100%	0	>90	3%	head wall of flow slide in pit has moved 12 m in one season. Slurry has flowed 43 m in same time. Head wall 2 m deep.	Aug. '72
130		134°18' 67°08'	G	tMm Poorly drained		Sb 7.5 5 >150 3000/ha with Ll, Salix & Myrica gale over Betula glandulosa	Sphagnum 37% Carex tussocks 33% Polytrichum sp 14% lichen & herbs 16%	humic organic	15-30	33-65 varying with micro-topography	Seismic line	May '70	2 1/4	trash & litter 43% Carex/wet moss 42% water w. Carex 15%	20	85	Level	no apparent degradation	Aug. '72
131	near #130	67°07' 134°15'	G	tMp Poorly drained		Sb 15 7 180 3000/ha with Ll and Alnus understorey	litter w. ericas 39% Cladina/ericas 36% Sphagnum 14% other spp. 11%	cryic rego-gleysol clay loam pH 7.6	36	30-54 varying with micro-topography	Seismic line	May '70	2 1/4	trash & litter 45% Sphagnum 23% residual lichens 15% ericas 14% water 3%	12	[illegible]	Level	38 cm settling in cut line in thermokarst holes	Aug. '72
132	N.W. of Fishing Lakes	67°03' 134°03'	F	tMp Poorly drained		Sb 10 6 ?200 2900/ha stagnant w. Ll some B.glandulosa mounded	Sphagnum 44% Cladina spp 44% liverwort & mosses 12%	humic organic	18	45	Seismic line	May '70	2 1/4	residual spp. 80% trash & litter 20%	40	51	Level	35-40 cm settling in cut line w. water-filled thermokarst holes	Aug. '72
133	west bank Arctic Red River	67°0[illegible]' 133°[illegible]'	F	tMv Poorly drained		Sb 9 10 ?150 3100/ha w. Ll, moribund stand, fire origin	lichens 39% mosses & ericas 32% Carex tussocks 15% liverwort 11% litter 3%	cryic rego-gleysol clay loam pH 7.4	15	85	Well site	April '71	1 1/2	bare with sparse Carex tufts E.scirpoides 87% E.arvense 8% mosses 5%	12	2.5°C at 60 cm rock prevented deeper probing	Level	no apparent degradation	Aug. '72
134	Dempster Highway near #129	67°23'30" 134°23'30"	F	tMh Impf. drained		Sb 10 11 130 5700/ha Ll 10 8 85	litter 53% mosses 23% lichens 14% herbs 10%	lithic regosol clay pH 6.1	27	55	Access road	1965 with subsequent use	7 1/2	trash & litter 55% residual communities 28% bare ground 11% Carex & other herbs 6%	12	>90	70%	50 cm settling in road	Aug. '72

TABLE 7.

AREA: Old Crow

No.	Site	Location	F.M.R.I. Type	Landscape Unit: GSC	Landscape Unit: CBC	Natural Community: Trees and Shrubs (dbh in cm, ht. in m, age in yrs.)	Natural Community: Ground Cover	Natural Community: Soil Type and Texture	Natural Community: Depth of Organic Layer cm	Natural Community: Depth to Frozen Layer cm	Disturbance: Kind	Disturbance: Season	Disturbance: Elapsed Time Yrs.	Disturbed Community: Ground Cover	Disturbed Community: Depth of Organic Layer cm	Disturbed Community: Depth to Frozen Layer cm	Slope	Remarks	Sampling Date
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
135	N.E. of Old Crow River	67°40' 139°42'	F	G_B 12 Impf. drained		Sw 1700/ha 12.5 12 200 Sb 700/ha 7.5 10 200 w. *Alnus* & *Salix* understorey over *B.glandulosa*	*H.splendens* & *T.nitens* 71% litter & lichen 21% *Carex* & forbs 8%	cryic rego-gleysol	13	85	Seismic line	May '72	1/4	bare soil 37% litter & trash 36% residual mosses 27%	7	≃ 110	8%	some small thermokarst holes apparent. 45 cm depression of cut line.	Aug. '72
											fire		? 15 yrs	lichens 85% *Carex* tufts 11% herbs 4% *B.glandulosa*, *Salix* Sw seedlings common	5	≃ 100	8%	no apparent degradation	Aug. '72
136	Old Crow & Porcupine Confluence	67°34' 139°44'30"	I	si/g Apt Poorly drained		scattered small Sb over *Salix/Alnus* thicket with *B.glandulosa*, hummocky	*Sphagnum* tussock 66% Erica mounds 24% *Carex* tussocks 10%	humic organic	>25 charcoal at 25	25	Access road	May '72	1/4	residual erica mounds 70% residual *Sphagnum* tus. 20% residual *Carex* tuss. 7% water & litter 3%	>25 water at surface	60	Level	road depressed, no apparent degradation	Aug. '72
137	Lord Creek	67°21' 139°00'	G	s,si_L 231 Poorly drained		Sb 7100/ha 7.5 7 150 open *Salix* understorey over *B.glandulosa* hummocky	lichen & litter 68% *Sphagnum* 33%	cryic dystric brunisol silty-clay loam pH 4.8	6	37-70 varying with micro-topography	Seismic line	May '72	1/4	residual communities 100%	1	40-75	3%	only slight surface disturbance, no apparent degradation	Aug. '72
138	G.U.S. runway	67°03' 138°36'	H			scattered *Salix* over *B.glandulosa* w. *Spirea beauvardiana*	mosses 47% grasses 26% lichens 15% bare ground 12%	lithic regosol silty loam pH 4.5	1	too rocky to be probed	Airst strip constr.	May '72	1/4	bare ground with many stones 100%	0	too rocky to be probed	6%	no apparent degradation	Aug. '72
139	Rat Indian Creek	67°35' 138°15'	F	si/g Af Impf. drained		Sb 1800/ha 12.5 10 150 over-mature stand w. *Salix* and sparse *B.glandulosa*	lichen, mosses 39% mosses, ericas 35% moss, sedges 26%	rego-gleysol clay loam pH 5.7	12	50	Winter road	May '71	1 1/4	residual moss/sedges 47% residual lichen/moss 24% residual moss/ericas 21% debris 8%	9	50	4%	disturbance superficial no apparent degradation	Aug. '72
140	Driftwood River	67°38'30" 138°34'	⊕	si,s_B 12 Impf. drained		Sb 60,000/ha 2.5 2 20	litter 54% mosses 20% *Carex* 13% other spp. 13%	cryic gleysol	2	75	seepage of mineral rich water	?	since burning?	bare ground with water and some *Carex* 100%	3	90	6%	seepage lines are eroding to form gullies. An excess of sulphur in the seepage water is suspected.	Aug. '72
141	Berry Creek	67°29' 137°55'	G	si,sh,s_L 213 Impf. drained		Sb 8300/ha 7.5 7 210 with Sw and scattered *Alnus* clumps	*Carex* tussocks 68% *Ledum palustre* 31% *Eriophorum* tussocks 1%	cryic dystric brunisol silty clay loam pH 5.00	17-30	30	Seismic line	May '71	1 1/4	residual *Carex* 75% residual *Ledum* w. lichen 25%	20	45	15%	no apparent degradation	Aug. '72
142	Berry Creek	67°29' 137°53'	G	gAt Poorly drained		*B.glandulosa* moor with a few small, scattered Sb, hummocky	*Sphagnum* hollows 55% *Carex* mounds 45%	rego-gleysol silty clay pH 4.1	21	42	Access road	May '71	1 1/4	*L.palustre* 52% scraped *Carex* mounds 37% litter & debris 11%	22	40	Level	only surface disturbance no apparent degradation	Aug. '72
143	Driftwood headwaters	67°45' 138°15'	F/H	cg_B 12 Poorly drained		Sb 1400/ha 7.5 4.5 175 sparse *Alnus* understorey w. *B. glandulosa*	mosses and *Peltigera* sp 53% litter w. *L.palustre* 32% *Carex* tussocks 15%	rego-gleysol silty clay loam pH 5.1	9	50-70 varying with micro-topography	fire	?	25 ?	*Salix* canopy 20% *Carex* & mosses 54% mosses & herbs 28% *Carex* tussocks 18%	7	80	2%	no apparent degradation	Aug. '72
											Seismic line	May '72	1/4	mosses & *Peltigera* 75% *Carex* tussocks 21% litter 4%	5	70	2%	no apparent degradation	Aug. '72
144	near Bell River	67°25' 137°22'	F/H	sh,s^B_d 12 Poorly drained		Sb very open stand 5 3 90 scattered *Salix* clumps w. *B.glandulosa*	*Carex* tussocks 43% *Sphagnum* mound. 36% *Sphagnum* hollows w. water 21%	cryic rego-gleysol silty clay pH 4.8	25	50	Access road	May '71	1 1/4	residual communities 100%	20	50	Level	slight increase in surface water is only change	Aug. '72
145	1 mile west of #144	67°25' 137°22'30"	G	sh,s^B_d 12 Poorly drained		open Sb over *B.glandulosa* muskeg hummocky	*Sphagnum* 64% *Polytrichum* 35% *Carex* tussocks 1%	mesic organic	35	50	Access road	May '71	1 1/4	*Sphagnum* 75% *Polytrichum* 23% *Carex* tussocks 2%	30-35	67	2%	several shallow ruts formed 20 cm. No apparent harm	Aug. '72
146	west of LaPierre House	67°26'30" 137°29'	F	s,sh_S 213 Impf. drained		Sb 6700/ha 7.5 6 110 stagnant stand with *Salix/Alnus* understorey and *B.glandulosa* prominently hummocky	lichens 56% *Sphagnum* 42% *Carex* tussocks 2%	cryic rego-gleysol clay loam	6	38-75 varying with micro topography	Seismic line	Dec. '71	1 3/4	residual lichens 58% residual *Sphagnum* 39% mud (in ruts) 3%	5-7	35-75	14%	ruts to 40 cm formed in cut line	Aug. '72
147a		67°28' 137°39'30"	E	si,s,sh_M 321 Impf. drained		Sb 3300/ha 7.5 10 120 scattered Bp with *Alnus* & *B.glandulosa*	*Sphagnum* 63% ericas w. litter & lichen 35% bare ground 2%	cryic gleysol	2	60	Seismic line	May '71	1 1/4	rubble & debris 79% bare rutted soil 21%	0	65	15%	ruts 60 cm deep on west aspect	Aug. '72
147b		67°28' 137°39'30"	E			Sb 4000/ha 7.5 8 120 Bp (higher proportion than in 147a) *Alnus* & *B.glandulosa*	*Sphagnum* 36% mosses w. ericas 26% lichen w. ericas 25% litter w. ericas 13%	cryic gleysol silty clay pH 4.1	14	30-60 varying with micro topography	Seismic line	May '71	1 1/4	residual *Sphagnum* 36% bare mineral soil 35% litter & debris 25% ericas 4%	0	65	15%	ruts 45 cm deep on east aspect	Aug. '72
148		67°27'30" 137°43'	F	s,sh_H 213 Poorly drained		Sb 7400/ha 7.5 4 90 scattered Bp with *Alnus* & *B.glandulosa*	lichens, mosses 47% *Sphagnum*, ericas 28% mosses w. *Ledum* 14% other forbs 11%	cryic gleysol silty-clay loam pH 5.05	3	15-85 varying with micro topography	Seismic line	May '71	1 1/4	bare ground 52% residual *Sphagnum* 24% litter & debris 14% other forbs 10%	2-3	15-90	Level	very slight depression of cut line	Aug. '72
149	3 mls. east from Old Crow	67°33' 139°45'	B	si/g Apt Impf. drained		Sw 1000/ha 7.5 5 44 *Salix/Alnus* understorey	mosses 65% litter 34% *Carex* 1%	alluvial regosol sandy loam pH 6.9	11	60	Access road	May '72	1/2	bare ground with sparse *Equisetum* spp. 73% rubble 27%	8	65	3%	0.7 m gully down river bank	Aug. '72
150	near #149	67°33' 139°45'	E	si/g At Poorly drained		*Picea* spp. 6200/ha 7.5 10 100 low *B.glandulosa* understorey	mosses 89% *Carex* tussocks 11%	cryic gleysol sandy loam pH 7.3	18	55	Access road	May '72	1/2	mosses w. *Carex* 40% litter & trash 28% *Equisetum* spp. 26% water 4%	15-20	85	Level	no apparent degradation	Aug. '72

TABLE 8

AREA: Inuvik

				LANDSCAPE UNIT		NATURAL COMMUNITY					DISTURBANCE			DISTURBED COMMUNITY					
No.	Site	Location	F.M.R.I. Type	GSC	CBC	Trees and Shrubs dbh in cm / ht. in m / age in yrs.	Ground Cover	Soil Type and Texture	Depth of Organic Layer cm	Depth to Frozen Layer cm	Kind	Season	Elapsed Time Yrs.	Ground Cover	Depth of Organic Layer cm	Depth to Frozen Layer cm	Slope	Remarks	Sampling Date
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
151	Dempster Hgwy near Lower Ramparts	67°29' 133°45'	L	tMm mod-well drained		Sw 2400/ha 5 10 45 Bp 100/ha 7.5 12 ? 50 *Shepherdia canadensis, Viburnum edule, Rosa* & *Salix* understorey	litter w. *Arctostaphylos uva-ursi* 100%	orthic eutric brunisol loam pH 5.6	5	52	Access road	Winter '72	1/2	Bare ground w. grass 52% rubble 30% water & rocks 10% herbs 8%	0	90	40%	severe gully erosion in existing water channel	Aug. '72
152	Dempster Hgwy at Rengleng River	67°45' 133°50'	E	tMp Impf. drained		*Picea* 4400/ha 10 7 80 Ll 200/ha 5 8 ? 80	Ericas/moss 86% Ericas/lichens 14%	cryic gleysol sand pH 6.9	9	50	Summer road	May '67	5 1/4	litter & trash 44% Erica/moss residual 35% exposed humus 11% residual Erica/lichen 10%	0-5	75	Level	rutted to 27 cm	Aug. '72
											Fire	?	? 25 yrs	sparse Ll 20 yrs, 3-5 m *V.uliginosum* with moss & litter 61% mosses 27% litter & lichens 12%	5-9	55	Level	no apparent degradation	Aug. '72
153	Dempster Hgwy north of Rengleng R.	67°48' 133°45'	C/K	tMp/Io Poorly drained		*Picea* 2400/ha 2.5 4 145 Ll 800/ha 7.5 6 46 May have been lightly burned recently, 2-aged stand suggests fire about 50 yrs. ago and fire scars are visible on *Picea*	*Sphagnum* 77% litter 7% *Polytrichum* sp 7% *Cladina* spp. 6% *Eriophorum* sp. 3%	humic organic	60	60	Summer road	May '67	5 1/4	litter & trash 84% residual *Sphagnum* 13% residual *Cladina* 3% very wet surface	50-60	80	Level	small thermokarst ponds forming, ruts to 40 cm.	Aug. '72
154	west of Dempster Hgwy	67°55' 133°40'	Ø	tMp Poorly drained		Burned about 25 yrs ago; no live trees in the area. A second, light fire burned through in '71. Conspicuously mounded. Some *Salix* sp & *B.glandulosa* clumps	*Epilobium* & herbs 36% *Ledum palustre* 36% *Marchantia polymorpha* 14% *E.arvense* 11% mixed spp. 3%	cryic gleysol silty clay pH 4.3	28	80	Summer road	May '67	5 1/4	open water 25% litter & trash 22% moss & *M.polymorpha* 20% moss & *Equisetum* 14% *Epilobium* sp 12% burned humus 7%	36	55	Level	ice lenses present beneath some unburned *Sphagnum* mounds. Ruts to 50 cm deep	Aug. '72
155	Caribou Hills	68°32' 133°62'30"	Ø/H	Cx Impf. drained		brulé *Alnus incana* 2 m thicket *Salix* over *B.glandulosa*	Polygonally patterned w. sedge & tussocks *Vacc.vitis idaea* & lichens 89% mosses with *Ledum palustre* 11%	cryic regosol	18	58	Fire	?	recent	burned forbs & moss 92% *Marchantia polymorpha* 8%	12-18	60	5%	no apparent degradation	Aug. '72
156	Caribou Hills above & S.E. of Reindeer Station	68°39' 133°58'	H	Mvm Impf. drained		no undisturbed community in the locality polygonally patterned tundra; charred *Betula glandulosa* present		cryic regosol pH 3.6			Fire super-ficial	?	recent	burned organic matter 56% charred tussocks of *Eriophorum* 45% wet mosses 9%	5	37	Level	comparison of two intensities of burning, more surface water evident in more severely burned areas.	Aug. '72
											Fire intense	?	recent	burned organic matter 89% charred *Sphagnum* 7% charred tussocks of *Eriophorum* 4%	0	60	Level		
157	CNT line on Caribou Hills	68°39' 133°55'	H	L Poorly drained		sparse *Betula glandulosa*, no trees	*Sphagnum* & mosses & *Carex* 84% *Sphagnum* 13% *Carex* tussocks 3%	cryic rego-gleysol	28	30	Access road	Winter	1/2	residual *Sphagnum* 60% undisturbed *Sphagnum* 28% water & humus 12%	25	45	Level	ruts depressed 20 cm with standing water	Aug. '72
158		68°42' 134°00'	H	L Poorly drained		scattered *Salix* sp. over *B.glandulosa* on hummocky tundra, with frost boils	lichens 76% mosses 20% water 4%	cryic rego-gleysol clay pH 4.8	9-35	57	Seismic line	April '71	1 1/2	residual lichens 66% bared humus 32% litter 2%	10	70	Level	disturbance only superficial	Aug. '72
159	near Noel Lake	68°33' 133°35'	H	L Poorly drained		*Salix* & *B.glandulosa* on former banks		lacustrine silt			natural pond	emptying of	a small	canopy of *Eriophorum* sp 80%	0-1	>90	Level	a natural phenomenon	Aug. '72
160	Caribou Hills	68°29' 133°40'	H	Mm Impf. drained		*Alnus* dense thicket - 3 25	charred humus 67% litter 24% lichens 9%	cryic regosol	0-5	60	Fire Second fire		>25 1969	bare 100%	0	?		mud flow slides in brulé following second fire on 5-15% slopes	Aug. '72
161	near Campbell Lake	68°16'30" 133°19'	G	Mp Poorly drained		Sb scattered through *Salix* thicket with *Betula glandulosa* 60	mosses 50% sedge tussocks 44% water w litter 6%	cryic regosol clay pH 5.5	10-14	50	Access road	Winter '72	1/2	Litter & trash 57% mosses 32% water w. herbs 11%	10	>90	Level	60 cm rutting in road with increased surface water	Aug. '72
162	Campbell Lake	68°13' 133°14'	D/Ø	Md R Impf. drained		brulé Sb & *Alnus* thicket over *B.glandulosa*; hummocky Sw & Bp in immediate vicinity	ericas & lichen 56% mosses & ericas 32% *Sphagnum* 12%	cryic regosol sandy clay loam pH 5.6	12	31	Access road	Winter '72	1/2	incorporated humus 51% debris & litter 26% forbs 17% mosses 6%	8	50	12%	55 cm depression in road subsurface sand moving in water where soil pit was excavated	Aug. '72
163	creek north of Campbell Lake	68°16'30" 133°16'	D/Ø	Md R Poorly drained		brulé sparse surviving Sw over *Salix* clumps with *B.glandulosa* small hummocks	mosses 59% ericaceous forb 33% litter & lichen 8%	cryic regosol sandy clay loam pH 5.2	16	37	Access road	Winter '72	1/2	mineral soil 48% water 20% grass & bare soil 16% trash & litter 16%	Surface water	70	Level	60 cm depression in ruts	Aug. '72
164	south of Campbell Lake	68°09' 133°26'	E/H	Mp Poorly drained		Sb 3400/ha 5 5 60 Sw 600/ha 5 6 60 *B.glandulosa* to 1.5m understorey	litter w ericas 55% moss 37% sedge tussocks 8%	cryic regosol clay pH 5.9	18	70	Access road	Winter '72	1/2	rubble 53% mud & litter 36% water 11%	moving water on road surface	70	Level	26 cm depression in ruts. Muddy water flowing from end of construction berm as if from melting glacier.	Aug. '72
165	Dempster Hgwy	68°04' 132°28'	F	Mm Poorly drained		Sb 500/ha 5 4 ? with sparse Bp over *B.glandulosa* and *Salix*	ericas & moss 52% ericas & litter 25% ericas, sedges & lichens 23%	cryic regosol sandy clay loam pH 4.7	17	38	Seismic line	May '72	1/4	bare w. sparse herbs 62% water w. sedges & *Equisetum* 24% trash & litter 14%	10-12	80	Level	55 cm depression in centre of cut line.	Aug. '72
166	near Jurassic Butte	68°03'30" 135°25'	F	N.A.		Sw 3000/ha 3 5 150 *Alnus/Salix* understorey (2 m tall) low hummocks	mosses 83% litter 10% ericas 7%	cryic regosol sandy clay loam pH 5.9	15	30 with ice lenses	Seismic line	May '72	1/4	residual mosses 62% sparse herbs & litter 24% trash & litter 14% depressions water-filled	5	60	7%	40 cm depression of cut line	Aug. '72
167	adjacent to #166	68°03'30" 135°25'	F	N.A.		Sw 700/ha 10 6.5 110 scattered Sb (155 yrs) with *Alnus* & *Salix* clumps over *Betula glandulosa*	lichens 86% moss & lichen 14%	cryic regosol loam pH 6.9	10-18	75	Seismic line	April '72	1/4	rubble 56% humus w. *Equisetum arvense* 33% residual lichens 11% depressions water-filled	5-10	too wet for accurate measurement	4%	53 cm depression of cut line	Aug. '72
168	Beaver Creek	68°22'30" 135°32'	H	N.A.		Sedge tussock moor with *Betula glandulosa* & procumbent *Salix*	lichen/sedge/erica mounds 78% *Sphagnum*/erica depressions 22%	cryic rego-gleysol clay pH 4.1	7-15	40-65	Access road	April '70	2 1/2	bare soil 54% residual communities in depressions 42% water 4%	0-5	40-75	10%	surface roughly smoothed by by disturbance. No apparent degradation.	Aug. '72
169	Mt. Gifford foothills	68°09' 135°22'30"	H	N.A.		open thicket of dead *Salix* with *B.glandulosa*	*Ledum palustre* 42% lichen w.ericas 41% *Vacc.vitis-idaea* 17%	cryic regosol silty clay pH 4.3 charcoal at 7-12 cm	7	30	Seismic line	April '72	1/4	trash & litter 51% mosses 22% trampled residual communities 21% water 6%	0-5	50	2%	cause of death of *Salix* was not determined. 45 cm depression in cut line.	Aug. '72
170	Coal Mine L Lake	68°41' 136°19'	H	N.A.		scattered small *Salix* over *Betula glandulosa* with frost boils	lichen mounds 85% *Ledum palustre*/moss 12% bare mineral s. 3%	cryic regosol clay loam pH 3.9	0-3	50	Seismic line	Aug. '68	4	residual mounds 94% residual mosses 6%	0-3	50	8%	no apparent degradation disturbance barely discernible	Aug. '72
171a	near Cache Creek	68°30' 136°10'	H	N.A.		diffuse *B.glandulosa* with some *Salix* tussocks moor with frost boils	*Sphagnum*/moss 34% Sedge tussocks 31% erica mounds 29% bare min. soil 6%	cryic rego-gleysol clay pH 3.7	0-16	30-50	Access road	Feb. '71	1 1/2	residual mosses 40% rubble 28% residual tussocks 27% bare soil & ericas 5%	0	25-55	3%	only superficial disturbance no apparent degradation	Aug. '72
171b	near Cache Creek	68°30' 136°10'	H	N.A.		high-centred polygons with *B.glandulosa*	*Sphagnum*/erica 43% erica mounds 34% sedge tussocks 23%	cryic rego-gleysol clay pH 3.9	30	30	Access road	Feb. '71	1 1/2	residual *Sphagnum* 39% rubble 34% residual erica mounds 24% bare soil	0-30	30	3%	slight surface disturbance raised polygons possibly blown clear of snow, no damage	Aug. '72
172		68°28' 135°35'	H	N.A.		sparse *Alnus* over *B.glandulosa* sedge tussock moor with weakly-defined polygonal pattern	erica & lichen 58% *Carex* tussocks 22% *Sphagnum*/erica 20%	cryic rego-gleysol clay loam pH 4.2	0-5	35-40	Seismic line	April '72	1/2	residual erica/lichen 46% trash & debris 30% bare soil & water 12% residual lichen & *Sphagnum* associations 12%	0	60	6%	30 cm depression in cut line only surface disturbance	Aug. '72
173	west of Point Separation	67°37' 134°15'	C	tMpv Poorly drained		Sw 1900/ha 20 17 225 open *Salix* & *Alnus* understorey	*Tomenthypnum nitens* 59% litter 14% *E.scirpoides* 12% mosses 15%	cryic regosol clay pH 7.4	18	30	Well site	May '66	6 1/4	rubble & debris 30% bare ground 70%	0	40	Level	no apparent degradation	Aug.'72
174	Indian Village	67°39' 134°30'	C	siApk Impf. drained		Sw 2500/ha 17.5 20 250 open *Salix/Alnus* understorey	mosses 59% litter 41%	cryic regosol silt loam pH 7.7	8	48	Seismic line	May '66	6 1/4	rubble & debris 56% moss with forbs 44%	8	72	Level	45 cm depression of surface	Aug.'72
175a	near #174	67°37'30" 134°30'	C	siApk Impf. drained		Sw 1200/ha 25 18 210 open *Salix/Alnus* understorey	*H.splendens* 48% other mosses 30% litter 22%	cryic regosol sandy clay loam pH 7.6	8	35	SSeismic line	May '66	6 1/4	rubble & debris 48% residual mosses 52%	0-10	55	3%	15 cm depression of cut line	Aug. '72
175b	near #174	67°37'30" 134°30'	?			Sb 3200/ha 7.5 4 ? over dense *Salix/Alnus* under-storey	*Arctostaphylos rubra* 55% mosses 28% litter 7% poorly drained	cryic regosol	5-8	45	Seismic line	May '66	6 1/4	rubble & debris 56% *Arcto. rubra* 26% litter 10% residual mosses & water 8%	5	47	3%	18 cm depression of cut line	Aug. '72
176	Airstrip near #173	67°37' 134°15'	I(?)	siApk Poorly drained		Sw very sparse over *Alnus/Salix* thicket up to 2 m tall	mosses 41% *Tomenthypnum nitens* 35% litter 17% sedge tussock with *E.scirpoides* 7%	cyric(?) regosol	5-10	55	Air-strip	May '66	6 1/4	bare soil with sparse grass & *E.arvense* 91% residual mosses 9%	0-5	87	Level	no apparent degradation	Aug. '72
177	North of Tuktoyaktuk	69°31' 132°45'30"	H	Mk Poorly drained		Arctic tundra with scattered low *Betula glandulosa*, hummocky	*Sphagnum* 51% *Carex* tussocks 47% bare soil 3%	cryic-rego-gleysol clay pH 4.4	14	22-30	Seismic line	May '67	5 1/4	residual *Sphagnum* 27% residual *Carex* 23% bare ground 20% *Calamagrostis* sp. 18% rubble 12%	incorpor-ated	40	Level	Seismic line deeply excavated, now wet, 68 cm below former surface level	Aug. '72
178	I.O.E. Well Kimik D29	69°38' 132°20'	H	^{p}F^{G} s p Poorly drained		Arctic tundra with scattered low *Salix* and *B.glandulosa* on windswept hillock.	*Carex* mounds 49% moss in hollow 48% *Carex* tufts 3%	cryic rego-gleysol pH 5.5	3	30	Access road	Feb. '72	1/2	bare soil 78% residual "hollow" association 22%	0	65	Level	no apparent degradation	Aug. '72
179	near Hutchison Bay	69°35' 132°05'	H	Mv sF Impf. drained		Arctic tundra with scattered low *Salix* and *B.glandulosa*	erica/lichen mounds 62% ericas/moss hollows 36% *Carex* tufts 2%	cryic regosol sandy clay loam pH 6.1	5-15	40	Seismic line	May '67	5 1/4	bare soil 36% erica/lichen mounds 33% residual mosses 13% other spp. 18%	0-10	90	14%	excavated into mineral soil now cut line 1 m deep Parallel surface disturbance line is depressed 10 cm	Aug. '72
180	north east of Tuktoyaktuk	69°30' 132°39'	H	L Poorly drained		High-centre polygons in shallow basin, sparse low *B.glandulosa*	lichen/ericas/ litter 81% *L.palustre* 16% *Carex* tussocks 3%	humic organic	30	30	Gravel berm road	May '72	1/4	gravel 76% mixed gravel & residual associations 22% water 2%	0	55	Level	10 cm gravel berm did not protect permafrost table from thawing	Aug. '72
181	south of Tuktoyaktuk	69°09' 133°11'	H	Mk Impf. drained		Arctic tundra with low open *Salix* thicket over *B.glandulosa*	lichen/ericas on mounds 59% moss/ericas in hollows 41%	cryic regosol clay pH 4.9	5	30	Seismic line	May '67	5 1/4	trash & litter 54% *Calamagrostis* sp 17% bare ground 8% residual associations 21%	0-7	55 below grass, >90 below wet trench	8%	deeply bulldozed seismic line now 80-85 cm deep	Aug. '72
182	west bank of Eskimo Lake	69°00' 133°15'	H	L^{G} Impf. drained		Arctic tundra with low open *Salix* thicket over *B.glandulosa*	moss/ericas 52% lichen/ericas 18% *Sphagnum* 15% litter w. *Empetrum nigrum* 15%	cryic regosol loam pH 6.7	10	40	Airstrip	April '71	1 1/2	trash & debris 73% water 16% residual spp. 11%	3-7	75	Level	50 cm depression of airstrip now very wet	Aug. '72

(Continued)

TABLE 8 (Continued)

AREA: Inuvik

No.	Site	Location	F.M.R.I. Type	LANDSCAPE UNIT GSC	CBC	NATURAL COMMUNITY Trees and Shrubs dbh in cm / ht. in m / age in yrs.	Ground Cover	Soil Type and Texture	Depth of Organic Layer cm	Depth to Frozen Layer cm	DISTURBANCE Kind	Season	Elapsed Time Yrs.	DISTURBED COMMUNITY Ground Cover	Depth of Organic Layer cm	Depth to Frozen Layer cm	Slope	Remarks	Sampling Date
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
183	adjoining #182	69°00' 133°15'	H	L^G Impf. drained		Arctic tundra with low open *Salix* thicket over *B.glandulosa*	lichen/ericas 51% moss/ericas 44% bare soil 4% *Carex* tufts 1%	cryic regosol loam pH 7.0	7-23	30	rubble & trash covered test strip	April '71	1 1/2	rubble & debris 73% residual associations 27%	20-30	35	Level	retention of or addition to vegetative and organic layers has preserved permafrost, exposure of mineral soil has lowered permafrost by 83%	Aug. '72
											bared hollows	April '71	1 1/2	bare ground 84% water 9% *Carex* & grass spp. 7%	7-10	55	Level		
184	adjoining #183	68°58' 133°20'	H	L^G, Poorly drained		Scattered *Betula glandulosa* over sedge & ericaceous forbs, hummocky	ericas & lichen on mounds 61% sedge/moss tussock with ericas 39%	cryic regosol	13	33	Fire	?	? 2 yrs	lichen/*Arcto.rubra* *Vacc.ulginosum* 53% moss/*V.ulginosum* *A.rubra* 47% charcoal evident in organic layer	7	49	Level	no apparent degradation change in community composition	
185	S.W. from Eskimo Lake	68°45' 132°29'	H	Mh(k) G Impf. drained		Scattered *B.glandulosa* over Arctic tundra with conspicuous "frost boils"	*Sphagnum*/erica 45% lichen mounds 38% *Eriophorum* tussocks 15% bare soil 2%	cryic rego-gleysol clay pH 4.3	0-5	30-60 with clear ice	Seismic line & summer road	May '67	5 1/2	ericaceous spp. 44% *Eriophorum* tussocks 26% crushed lichen mounds 18% bare soil with some moss 12%	35 saturated at surface	55	2%	disturbed line depressed with ruts 40 cm deep	Aug. '72
186	5 km N.W. from Inuvik	68°23' 132°45'	G	Mp Poorly drained		Sb 400/ha 5 5 65 *Alnus*/*B.glandulosa* understorey	*Sphagnum*/erica 68% bare soil 16% *Carex* tussock 12% lichens 4%	cryic rego-gleysol clay pH 3.7	0-20	30-80	Fire	1969	3	Scatter Sb & Bp over charred erica mounds 34% burned mounds 32% residual *Sphagnum* 16% water 12% residual tussocks 6%	0-3	50-90	1% at foot of slope	fire burned unevenly, general reduction in height of mounds increase in thickness of active layer	
								-			Bull-dozed fire-break	1969	3	bare soil with some litter 73% water 15% *Eriophorum* tussocks 12%	0	55		fire-break now 2.2 m deep	
187	Inuvik Quarry Hill	68°19'30" 132°40'	O/G	Mh Impf. drained		Sparse Bp and Sb in *brulé* in former open woodland	*Funeria hygrometrica* 53% *Marchantia polymorpha* 23% sparse *Epilobium* & *Calamagrostis* spp. 14% litter 10%	cryic regosol clay loam pH 6.9	4	80	Access Road	? summer	? 3	bare soil w. litter 60% water 15% soil & gravel 13% *Eriophorum* tussocks 12%	0	>90	14%	road now eroded 25 cm	Aug. '72
														bare soil w. scattered 85% *Epilobium* & *Calamagrostis* mineral soil 7% water & gravel 8%	0	>90	35%	75 cm gully down former access road, on steeper slope	
188	Noel Lake in Inuvik burn area	68°28' 133°36'	O/H	Mm Impf. drained		Sparse *Betula glandulosa* in *brulé* in Arctic tundra	bare soil 33% charred mosses 31% *Sphagnum* 22% *Eriophorum*/moss tussocks 14%	cryic regosol	0-5	40-70	Access road	?	>3	bare soil 45% residual moss 23% charred moss 18% *Eriophorum* tussocks 11% organic debris 3%	incorporated	48	6%	60 cm depression & rutting in access road. Road apparently preceded fire. Severe burning has lowered permafrost table more than road constr. & use.	Aug. '72
189	Pierre Creek	67°21'30" 133°15'	O/F	tMp Impf. drained		*brulé* with sparse Sb and Bp, some *Salix interior* clumps; hummocky	charred mosses 53% moss 31% water 9% *Carex* tussocks 7%	cryic rego-gleysol clay pH 6.1	5-17	68	Access road	?	preceded fire in 1968	charred mosses 38% bare soil w. grass & *E.arvense* 26% *Marchantia polymorpha* 26% bare soil 5% water 5%	incorporated & saturated	>90	5% on lower slope	1 m gullying in old access road; gully is 2.5 m deep in mid-slope where angle is 10%	Aug. '72
190	adjacent to #189	67°21'30" 133°15'	O/G	tMp Poorly drained		*brulé* with sparse Sb and some small *Salix* sp. clumps	charred mosses 52% charred humus 41% bare soil 7%	cryic rego-gleysol clay pH 6.3	0-5	>90	Access road	?	preceded fire in 1968	residual charred moss 54% charred humus 33% bare soil 13%	0-5	>90	2%	no apparent degradation cf. 189 above	Aug. '72
191a	east of Pierre Creek	67°22' 133°02'	D	tMp Impf. drained		*Picea* 3860/ha 20 11 170 vigorous *Alnus*/*Salix* under-storey, small admixture of Bp	*Ptilidium*/erica 53% litter 25% lichen 13% *H.splendens* 9%	cryic regosol clay loam pH 5.8	10	65	Fire	Summer	? 4	*Marchantia polymorpha* 40% charred humus 38% moss 11% charred grass 6% residual lichen 4% bare soil 1%	7	>90	3%	no apparent degradation	Aug. '72
											Seismic line	May '67	5 1/4 i.e. before fire	*Calamagrostis* 29%, lichen lichen 17%, moss/erica 16% bare soil 16%, *Ptilidium*/ ericas 14%, mosses 8%	0	>90	3%	very slight depression of cut line	
191b	adjoining #191a		G			Sb 1100/ha 10 6 145 typical "drunken forest" with many dead trees with *Alnus*/*Salix* understorey	moss/ericas 42% lichens 31% mosses/ericas/lichens 27%	cryic rego-gleysol clay loam	18	55	Seismic line	May '67	5 1/4	incorporated humus 32% debris 30% water 25% sparse herbs & moss 9%	incorporated & saturated	>9	Small basin	much water and mud in cut line, very slow recovery	Aug. '72
192	Sandy Lake	67°48'30" 132°08'	D	U Impf. drained		old recovering *brulé* *Picea* 1000/ha 2.5 6 42 Bp 5 6 29(?) scattered *Alnus*/*Salix* clumps, low hummocks	litter 61% lichens 22% *Empetrum nigrum* 12% ericas & moss 5%	cryic eutric brunisol sandy clay loam pH 7.7	30-35	60	Seismic line	May '67	5 1/4	rubble & debris 43% mosses 25% litter & humus 14% erica mounds 12% bare soil 6%	8	>90	3%	23 cm settling in cut line	Aug. '72
193a	Martin House	66°53' 133°03'	F	cx Impf. drained		*brulé* in *Picea* stand 60 yrs ago Now dense *Picea*, mostly Sb with *Salix* & *Alnus*, pronounced hummocks	litter 47% moss/ericas 36% lichens 17%	cryic eutric brunisol clay loam pH 7.4	10 with charcoal	50	Seismic line	April '70	2 1/2	litter 39% rubble & debris 20% bare ground 20% residual herbs & moss 21%	5	90	21%	Aspect 067° no apparent degradation	Aug. '72
193b	Martin House	66°53' 133°03'	D	cx Impf. drained		open *Picea* with Bp, some *Salix* clumps, pronounced hummocks	litter 50% erica mounds & herbs 44% mosses 6%	cryic eutric brunisol clay pH 6.4	2	5°C at 40 cm clay impenetr. below this	Seismic line	April '70	2 1/2	litter 38% residual mosses 28% bare soil 21% rubble & herbs 13%		6°C at 40 cm clay impenetr-able below this	19%	Aspect 247° no apparent degradation aspect affects stand composition	Aug. '72
194	Rock Creek	67°16' 133°39'	F	tMp Impf. drained		decadent stand, many layered trees with dead crowns Sb 5800/ha 10 9 200 with *Salix*/*Alnus* understorey	lichen/ericas 50% moss/ericas 34% litter 16%	cryic regosol clay loam pH 6.9	15	25	Seismic line	May '67	5 1/4	rubble 51% water 17% *Equisetum scirpoides* 12% *Eriophorum* sp. 11% bare soil 9%	incorporated & saturated	>90	4%	seismic line cut in seepage channel, now gully is about 1 m deep in line	Aug. '72